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ELECTROLYTIC CORROSION.

At the recent Philadelphia meeting of the American Institute of Electrical Engineers, Dr. Samuel Sheldon read an interesting paper, reprinted elsewhere in this issue, on "The Conditions of Electrolytic Corrosion in Brooklyn." The conditions leading to widespread electrolytic corrosion of underground piping would appear to be extremely favorable in Brooklyn owing to the magnitude of the electric railway system and the distribution of the power houses. As noted in the paper, during the rush hours no less than 47,000 amperes of current are required, but a small part of which finds its way back to the generators through return feeders. The small amount of electrolytic action which actually takes place is therefore significant in view of the scares which every now and then are worked up in other cities where conditions are apt to be much less favorable for corrosion. It will be noted that no electrolytic corrosion of the water mains has been discovered in Brooklyn, and that in only two cases has there been any corrosion of gas mains noted. Dr. Sheldon establishes by experiment the cause of the immunity of mains from corrosion, and disposes of some of the speculations on the subject which have been offered as facts. He found a very simple explanation—that such immunity is almost undoubtedly due to the protection afforded by the non-conductive silicious skin which is formed on the surface of the mains in the process of casting, and which remains unaltered underground.

In the usual survey made with a view to determining the danger from electrolytic corrosion, measurements of potential alone have been made. It has frequently been pointed out that difference of potential is not necessarily a criterion as to the amount of electrolysis to be expected, but this consideration has rarely been taken into account by "experts," who usually persist in basing their conclusions as to danger from electrolysis upon difference of potential alone, notwithstanding that it may happen that where the largest difference of potential exists there is least danger from corrosion, since the existence of a high e. m. f. at a given point may follow from a high earth resistance at that point. Probably one reason why account of earth resistances has not been taken has been the assumed difficulty of making measurements of such resistance. Dr. Sheldon, however, lays down in his paper a very simple and practical method, and with this at their disposal, there should be no reason hereafter for experts to omit resistance data from reports of electrolytic surveys, without which their conclusions are open to question.

ALUMINUM WIRE FOR LINE CONDUCTORS.

The most important contribution yet made to the subject of aluminum wire for line conductors is a paper by Prof. Perrine and Mr. F. G. Baum, read at the recent general meeting of the American Institute of Electrical Engineers, and reprinted elsewhere in this issue. While much has been written showing that from its properties and price aluminum wire is a strong competitor to copper wire, it yet needed the test of practice on a considerable scale to definitely settle the question. The above paper gives the result of experience with aluminum lines under conditions more unfavorable than are usually encountered in electrical transmissions, and therefore the verdict which it conveys in favor of the use of aluminum wire is one most likely to stand.

That failures have been encountered in using aluminum for line

conductors is not to be wondered at, in view of the several factors which have to be properly provided for in the use of such wire. As pointed out, one of these relates to the proper manufacture of the material, and doubtless from the experience gained from the defective lines to which the paper refers, and possibly from others, the manufacturers are now able to obviate the difficulty arising from the presence of impurities in the material. The other difficulties referred to, relating respectively to low and indefinite elastic limit, high coefficient of temperature expansion, and active electrolytic power, can each be satisfactorily overcome by adopting necessary measures. To provide for the first two it is more necessary than with copper conductors to definitely fix the sag, and in accordance with sag tables corresponding to the different temperatures that may obtain during the time the wire is being strung. As to jointing, the method suggested in the paper, though probably entirely efficient, is yet subject to a time test. As will be seen, the tests made as to the properties of the wire actually used, harmonize very well with the results of laboratory data heretofore published. The conductivity, as compared with copper was found to be about 60 per cent, and the weight for equal conductivity almost half that of copper, while the strength is about one-quarter greater.

Sine Curve Variation of E. M. F.

About five years ago a discussion extending over several months appeared in these columns on the merits of the sine curve form of variation of e. m. f. with respect to the practical applications of the alternating current. In this discussion the leading authorities of the world in alternating-current theory and practice joined; the subject was thoroughly considered from every standpoint, and the verdict was decidedly in favor of the sine form of variation. It was shown that with this form, the line dróp, reactance and eddy currents are a minimum, there is no accompaniment of resonance, and no back torque created in induction motors. Moreover, since receptive devices should be supplied with an e. m. f. of the same form of variation as that of their reactive e. m. f., the sine curve furnishes a natural and the simplest standard to conform to this necessary requirement.

The only exception in the opinion expressed in favor of this conclusion was with respect to hysteresis, one of the authorities on this subject holding that a flat-topped curve gives a smaller hysteretic loss than one of greater gradient, as the former for a given variation of e. m. f., and consequently given hysteretic loss, corresponds to a greater transfer of energy. This, however, was contested, and as any balance in favor of the flat-topped curve with respect to hysteresis would have placed against it disadvantages with respect to other factors of a circuit, an unqualified verdict in favor of the sine curve may be considered as rightfully deserved, and not apt to be appealed from in the future.

More recently the advantages of the simple form of variation have been brought forward in still other connections than those considered in the discussion above referred to. One of these is with respect to transmission lines of very high voltage, where variations involving higher harmonics are considered to be the cause of momentary resonance discharges between line wires which, if the wires are not sufficiently far apart, may result in a continuous flaming arc, with consequent interruption of service. The other case refers rather to the advantages of the alternating current *per se* for cable signals, though here also the sine curve form of variation is that of maximum efficiency.

The use of the sine wave for cable telegraphy formed the subject of a paper by Capt. G. O. Squier and Prof. A. C. Crehore, presented at the recent Philadelphia meeting of the American Institute of Electrical Engineers, and an abstract of which and of the following discussion appeared in our report of that meeting. This paper opens up an inviting field, and the accompanying results of experimental investigations will be of the greatest assistance to future workers in it. The great commercial advantages which the use of the sine wave involves would be increase of speed due to the reduction of the signaling current to a minimum, and to a minimum distortion of signals. Still another advantage is that the sine wave would render unnecessary the devices now employed for discharging a cable, its harmonic variations involving this operation. As stated previously in these columns, with the present system of cable signaling, the full advantages of the sine wave cannot be availed of, and therefore await a signaling system devised to harmonize with the properties of the alternating current. Such a system may be contained in one lately described in patent specifications by Dr. Bedell, in which selected half-waves are suppressed.

Electric Traction in Great Britain.

That the backwardness of electric traction in Great Britain is due to causes not connected with its technical or commercial side, is a reasonable assumption in view of the great and profitable development of that industry in this country. The real cause, in fact, appears to lie in a conservatism of spirit and lack of enterprise which, extending also into the export industries, are beginning to place Great Britain at a disadvantage with her American and German rivals in foreign markets. As an illustration of the handicap referred to, the case of the Metropolitan Underground Railway of London is to the point. It appears that in 1897 a committee appointed by the Board of Trade recommended that electric traction be adopted for the operation of that railway. About a year later the Metropolitan directors, to quote from our English contemporary, *The Electrician*, "awoke from their lethargy to the extent of appointing two eminent engineers, a renowned bridge builder and a telegraph expert, to report to them about the possibilities of electric traction," and $100,000 were voted to enable an "experiment" to be made with electric traction. For this purpose a short length of the railway was equipped, and notwithstanding the stringent conditions imposed, when the directors came to view the experiment—to quote again from our contemporary—"the whole thing worked successfully—worked as any electrical engineer three years ago would have predicted it would do." Nevertheless, it seems that no move has yet been made toward equipping the line electrically, and our contemporary evidently fears that a complication may enter with respect to cost, should estimates of this be based upon the working of the experimental section, which was carried out without regard to economy of operation, and the equipment of which is not of a kind that would be recommended by engineers as a permanent equipment for an underground system. To Americans it appears odd that the suggestion for an industrial improvement should come from a governmental source. In fact, the entire history of electrical development in Great Britain indicates a reversal of the American order, the municipalities and governmental departments leading private enterprise in recognition of modern advances. Doubtless in many ways the latter is handicapped by restrictions unknown here, but this excuse evidently does not apply to the case of the Metropolitan.

The Measurement of Minute Intervals of Time.

An interesting paper by Messrs. Abraham and Lemoine appears in the May number of the *Journal de Physique*, containing a description of means for measuring very small intervals of time in certain physical experiments, and some particular measurements are given by way of illustration. Minute intervals of time have generally been measured electrically. For example, there is but little difficulty in measur-

ing the duration of the impact of a hammer when striking an anvil, by permitting a condenser to discharge through the point of contact and measuring the residual charge after the hammer leaps in recoil. Such time intervals are of the order of one ten-thousandth part of a second. Similarly, electric chronographs are usually employed to measure the interval of time between the passage of a projectile between two screens which it penetrates in succession. The unit interval of time, however, in the measurements here referred to, is the one-millionth of a second, and the capability of the method is said to descend to one-thousandth part of this time, or to the billionth of a second. The means employed are optical, and depend upon the enormous speed of light. For many years this enormous velocity of about 300,000 kilometres per second, or 7½ times round the globe per second, baffled the ingenuity of experimentalists to measure with precision, and now having been determined, this high speed is in turn utilized in the laboratory to measure extremely small intervals of time.

One of the applications of the method described in the paper is the determination of the time which elapses between the discharge of a condenser and the disappearance of Kerr's effect in its dielectric. A condenser formed of parallel plane plates separated by a transparent dielectric solution was arranged to be traversed by the rays of light emitted by spark-discharging terminals close by; the electrification of the condenser brought about polarization of the light passing through the dielectric. When the condenser was itself allowed to discharge at the spark-gap, the flash so delivered was found to be polarized, because the dielectric did not have time to recover from its electric stress in the interval of time between the discharge and the passage of the luminous flash through the discharge. If, however, the flash instead of being directed immediately through the dielectric solution was first passed around a rectangular loop by means of reflecting mirrors, the flash was found to be no longer perceptibly polarized when the preliminary path exceeded a certain distance, amounting to about 3 metres. Consequently in the time that light takes to traverse 3 metres, the dielectric had time to recover from its stress. This interval of time would be about the 1/100,000,000th second. Similar measurements are given of the time in which the rotatory polarization of light disappears under magnetic stress, and it was of the same order, although apparently about twice as great.

The method has its limitations, not only because it is necessarily confined to optical inquiries, but also because various assumptions enter into the measurement, such as the duration of the spark discharge, its rate of development, and so forth. But assuming the measurements given to be reliable, they point to the extraordinarily active condition of the molecules of electrified and magnetized matter which can respond in so very brief an interval to impressed electric and magnetic forces. Light can only run a few metres before the change is seemingly complete. Although the method employs the electric discharge to produce a very sudden and rapidly extinguished flash, yet it seems doubtful whether any wholly electric method could be developed which would possess the capability of measuring so minute an interval of time as the hundred-millionth of a second.

MAGNETIC LEAKAGE IN TRANSFORMERS.

The discussion between Messrs. Whitehead and Bijur, which has been taking place in our correspondence columns, is interesting as showing the differences of opinion which may arise over matters of terminology as distinguished from matters of fact. It seems to us that there is no essential difference between the views expressed on each side, but that there is a difference in the meaning attributed respectively to the term "magnetic leakage in a transformer," which term does not seem to have yet received accurate definition; and until it receives a generally accepted meaning capable of quantitative expression, such differences of opinion are likely to occur.

According to the modern theory of the transformer, the primary winding may be best conceived of as separated into two parts: the greater portion of which is completely interlinked magnetically with the secondary, while the lesser portion is closed magnetically upon itself alone, or is a simple choking coil. By further assuming that the resistance of the primary winding is entirely apportioned to the choking coil, we reach the conclusion that the primary winding consists of an ideally perfect induction winding devoid of resistance and completely interlinked with the secondary, in series with the choking coil, possessing both resistance and reactance. The same is true of the secondary winding, which is also a pure induction coil in circuit with an impedance coil. At no load, the influence of the choking coils is scarcely appreciable in the behavior of the transformer, but, as load is applied, we have an impedance drop in the primary and secondary choking coils, with magnetic fluxes in them proportional to the increasing current strengths, while the e. m. f. in the primary ideal induction coil is reduced by drop, and the flux in it is therefore slightly reduced instead of being increased.

The leakage in the transformer is broadly a phenomenon connected with the separation of the magnetic fluxes in the imaginary choking coils from the magnetic flux in the imaginary perfect induction apparatus. There are several ways in which the term might receive quantitative definition. For example, it might be defined as the ratio in the primary circuit of the flux in the imaginary choking coil to the flux in the combined choking coil and induction apparatus; or, it might be defined as the ratio of the self-induced reactive e. m. f. in the imaginary choking coil to the total self-induced primary e. m. f. Mr. Bijur has used the word in the sense of the difference between the flux passing through an exploring coil at the secondary winding and a similar exploring coil at the primary winding. In this sense his meaning seems to harmonize with all the contentions that have been set forth.

As to the amount of drop in the secondary terminal voltage due respectively to leakage and to resistance, that will depend not merely upon the amount of load, but also upon its nature; or, in other words, not merely upon the number of amperes, but also upon the phase of the secondary current due to inductive or non-inductive load. If the imaginary choking coil in the primary and secondary windings has relatively large reactance, the effect of secondary current phase displacement will be to modify the drop considerably; whereas, if the imaginary choking coils have but little reactance, phase displacement will not greatly influence the drop. In any case, however, the drop at non-inductive load is almost wholly due to resistance, in all well-designed transformers. The important consideration, therefore, to the purchaser or user of a transformer is the impedance in its primary and secondary choking coils; or, its total impedance in both choking coils together, if the transformer be regarded as level, i. e., of unit ratio of transformation. In this total impedance, the ohmic resistance of the coils is only one factor or part. The reactance factor of a well-designed transformer may be as low as 3 and as high as 17, depending upon the type of magnetic circuit and upon the amount of insulation space which has to be left between primary and secondary coils in order to withstand high pressures. Transformers appear to be on the market and in commercial use having this range. With a reactance factor of 10, the drop due to a heavily lagging current or the rise due to a heavily leading current may be much greater than the drop due to ohmic resistance, and yet the magnetic leakage in the sense in which Mr. Bijur uses the term may not be correspondingly large.

Northwestern Electrical Association.

The summer convention of the Northwestern Electrical Association will be held at Waupaca, Wis., on Tuesday, Wednesday and Thursday, June 26, 27 and 28. On Tuesday evening the excursion on the "Chain of Lakes" will be made in special steamers, and on Wednesday afternoon there will be "Olympian Games" for handsome prizes. On Wednesday evening there will be a performance of the "Northwestern Minstrels" at the opera house under the auspices of Mr. Jas. Wolff, terminating with a "Summer Night's Ball." On Thursday afternoon there will be tub races, swimming matches, boat races, etc. Those attending the convention are informed that every arrangement has been made for the comfort, convenience and pleasure of the ladies, who are especially invited to accompany their fathers, husbands and brothers.

Among the papers to be read are the following: "Testing," by W. H. Edgar; "Advantages of Recording Wattmeters on Switchboards," by W. Worth Bean; "Storage Batteries for Small Central Stations," by Louis A. Ferguson.

Independent Telephone Convention.

The fourth annual meeting of the Independent Telephone Association of the United States will be held in Cleveland, Ohio, June 12-14. The various railroad passenger associations have granted a one and one-third fare rate on the certificate plan to those in attendance, and the Cleveland hotels have accorded a reduced rate for accommodations. The Ohio Telephone Association has appointed a committee to assist in the entertainment of visitors.

The headquarters of the convention will be in the Electric Building, and will be opened at 8 o'clock on Tuesday morning for the purpose of registering and issuing credentials to the delegates and visitors. All persons are required to register before receiving credentials and tickets to the various entertainments. At noon the first session of the convention will be called to order. Following an address of welcome and the response, a business session will be held. The remainder of the day after lunch will be devoted to inspection of the various exhibits of manufacturers and supply men, which will be on the first, second and third floors of the Electric Building.

A reception will be given at 8 p. m. by the Cuyahoga and United States Telephone Companies, on the seventh floor of the Electric Building, at which time the offices of the different telephone interests, and the switchboard of the Cuyahoga Telephone Company will be thrown open to visitors. There will also be music, flowers and light refreshments.

The second session of the convention will be opened Wednesday morning at 10 o'clock by the annual address of the president, after which the following papers will be read: "Toll Line Traffic," by J. B. Ware, secretary and general manager, Citizens' Telephone Company, Grand Rapids, Mich.; "Telephone Development," by Ed. L. Barber, president, N. W. Telephone Construction Company, Wauseon, Ohio; "Telephone Investments," by Hon. Hugh Daugherty, president, United Telephone & Telegraph Company, Bluffton, Ind.; "Our Duty to One Another," by Hon. C. W. Kline, president, Interstate Telephone & Telegraph Company, Philadelphia, Pa.; "Telephone Construction," by James E. Stewart, consulting engineer, American Telephone, Telegraph & Cable Company, New York.

At 3 o'clock ladies attending the convention will be given a tally-ho ride through the parks and boulevards, leaving the Colonial Hotel at 2:30 p. m., the host being the Williams-Abbott Electric Company. In the evening, the ladies, delegates and friends will be entertained at Haltnorth's Garden, the Cleveland Electric Railway Company being the host.

At 10 o'clock on Thursday morning the third session of the convention will be opened. At this session officers for the ensuing year and new members will be elected. On Thursday afternoon, there will be a boat ride for delegates, ladies and friends, in the steamer City of Erie. The boat will leave the dock at 2 o'clock and return at 6 o'clock. In the evening, at 8 o'clock, the annual banquet will be held; Hon. Harry D. Critchfield, general counsel of the United States, will be toastmaster. The toasts will be as follows: "Our Guests," F. A. Henry, Cuyahoga Telephone Company, Cleveland, Ohio; "Why Are We Here;" "Frogs' Legs," Hon. E. B. Fisher, Citizens' Telephone Company, Grand Rapids, Mich.; "Sneak Currents," Hon. Z. S. Holbrook, president, Massachusetts Telephone & Telegraph Company, Boston; "Trouble Shooting;" "The Manufacturer;" "Patent Rights and People's Rights," Hon. S. P. Sheerin, president, New Long Distance Telephone Company, Indianapolis; "Our Hosts."

The following reception committee has been named: Messrs. H. W. Avery, A. M. Barnes, W. P. Bowman, H. J. Davies, S. R. Driffield, J. A. Ebersole, W. A. Foss, A. B. Foster, H. W. Jones, D. J. Kurtz, C. S. Powell, H. T. Pratt, L. Sands, Carl Seyler, William Smith, G. C. Steele, and C. W. Wason, chairman. The ladies on the reception committee will be Mrs. H. W. Avery, Mrs. H. J. Davies, Mrs. S. R. Driffield, Mrs. J. A. Ebersole, Mrs. F. A. Foss, Mrs. A. B. Foster, Mrs. H. W. Jones, Mrs. D. J. Kurtz, Mrs. H. C. North, and Mrs. L. Sands, chairman.

Automobile Run to Philadelphia.

On June 2, the Automobile Club of America had a run from New York to Philadelphia, returning on Sunday, June 4. The start was made at 7:30 a. m. from the Waldorf-Astoria on Saturday by twenty vehicles—8 steam machines, 9 gasolene vehicles and 3 electrics. Two of the gasolene vehicles did not belong to the club, and seemed to be sent out for advertising purposes. Ane of the electric autos was the Riker machine which captured the first prize in the 50-mile race between Springfield and Babylon, Long Island, a month ago. A stop was made at Princeton for dinner. President G. F. Chamberlain and his brother, C. C. Chamberlain, in a gasolene vehicle, were the first of the club members to reach the Bellevue Hotel in Philadelphia, the destination of the run. Apparently no effort was made to keep the vehicles together, as they straggled in at the finish. The return on Sunday was practically a repetition of the first half of the run, except that only 9 vehicles made the start for home. They arrived the same night. Because of the lack of order in which the motor vehicles left the Waldorf-Astoria Saturday morning, and the independent way in which they ran the distance, accurate details were difficult to obtain. The most novel vehicle in the run was an imported "theatre 'bus," under the direction of E. E. Schwartzkopf and a driver. Inside the 'bus were Gen. Roy Stone, Winslow E. Busby, William Hazelton and E. S. Hyatt. It was a gasolene machine of the "forecarriage" style. Other machines were occupied by Louis B. S. Myser and N. H. White, Dave H. Morris, George Isham Scott, chairman of the Tours and Runs Committee of the club; Gen. George Moore Smith, A. L. Riker and A. H. Whiting; S. T. Davis, who was second to Riker in the 50-mile road race on Long Island; H. R. Maxim, W. H. Hall, Capt. Homer W. Hedges, J. H. Milliken and H. M. McGee; H. M. Bylesby, Robert Graff and S. M. Butler. The late arrivals on Sunday night included Capt. Homer Hedges and Langdon Barber, in a steam machine; Harry L. McGee and Edwin Adams, in an electric surrey; L. R. Adams and Fred Gano, in a gasolene carriage; W. H. Hall and Henry N. Fletcher, in a gasolene runabout, and John Milliken and Robert J. Graf, in an electric surrey. The run was a go-as-you-please affair throughout.

Rebuilding at Ottawa.

Almost all the industries at the Chaudiere Falls, Ottawa, destroyed by the recent fire will, it is reported, be rebuilt without delay. The Ottawa Electric Railway Company intends shortly to commence building operations on a new power house similar in design and size to the new fireproof power house completed last winter and which escaped the fire. The new building will be erected on the site of the old one that was burned. It will be 60 ft. square and 40 ft. high, built of brick and concrete. A rock excavation, 10 ft. deep and the full size of the building, will be made. In the power house a 1600-hp generator and auxiliary machinery, of modern design, are to be established to replace the six generators destroyed in the fire. When the new machinery is installed the Electric Railway Company will have fully 3600 horse-power for operating purposes. The cost of the new building and plant is estimated at about $150,000. The Ottawa Electric Light Company will, it is reported, also expend a large sum of money in the erection of a new power house on the site of the arc light station No. 2. This will be made fireproof and fitted with modern machinery, similar to that in the electric railway power house. The cost of the building and plant will be about $100,000. The work on these houses will be pushed to completion. The Ottawa Carbide Company's new factory, which also escaped the fire, will be ready for operation within a few weeks.

Opening of the American National Pavilion and the American Machinery Building, Paris Exposition.

THE past week has been one of unusual interest in Paris to all good Americans, as the National Pavilion on the Rue des Nations was opened on May 12 and the American Machinery Hall at the Bois de Vincennes was opened on May 15. It is quite likely there will be other inaugurations under the flag at the Exposition as various sections and façades get finished, but these two will easily rank as the most important. So far as real utility goes, in helping the sale of American apparatus, it would have been much better to put Machinery Hall in the place of the Pavilion, but every country has its official headquarters on the beautiful Street of Nations, and it would not do for the United States to be found wanting in that respect. Moreover, it is curious to note how quickly the visitor of whatever race approves the lavish expenditure of money on the building which bears the official and national colors of his country, or grumbles if the outlay has been so small as to create a poor impression. At an international exposition more than anywhere else, a nation "stands up to be counted," in comparison with others, and the hasty impressions derived also in this manner by the vast crowds are apt to be lasting. Germany's magnificent façades in every direction, with well-displayed goods behind them, are matter of universal comment and appreciation, and must influence her trade most favorably; while Americans, of whom no fewer than 7000 are exhibitors, are not a little pleased when they note their country's prominence and activity at the last World's Fair of the century.

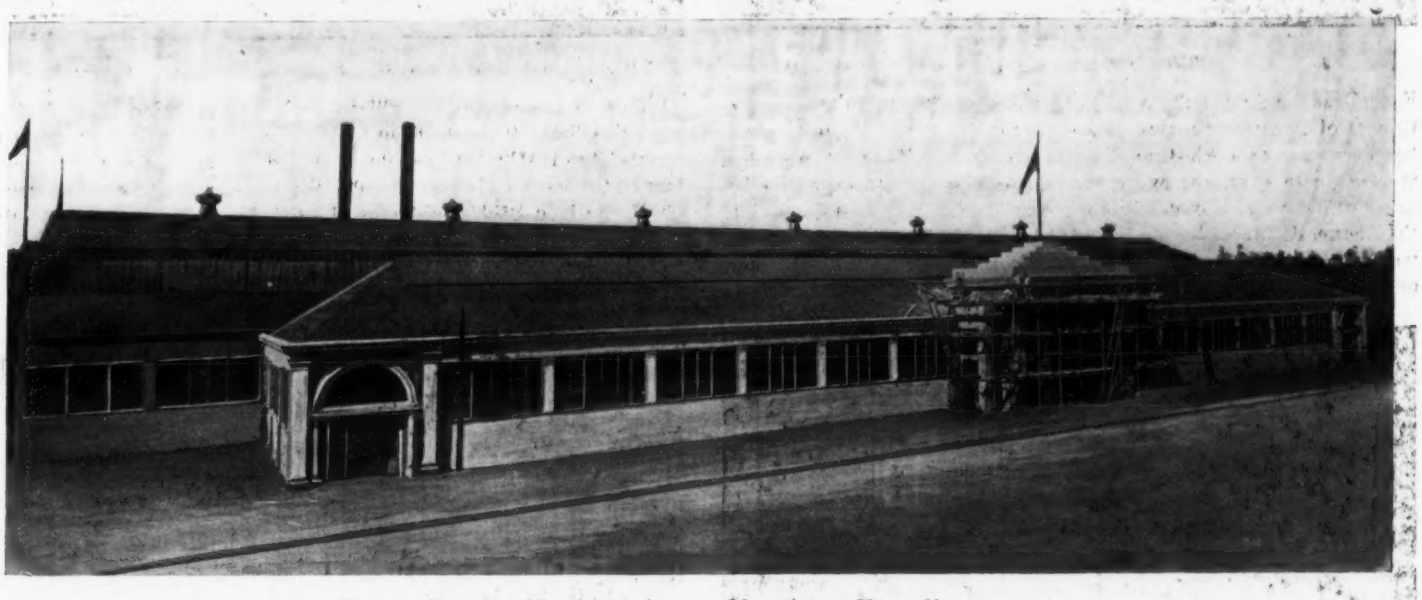

FIG. 1.—EXTERIOR VIEW OF AMERICAN MACHINERY HALL, VINCENNES.

The National Pavilion is classic in its style of architecture, and rises about 200 feet from the level of the quay on which it stands. The dome is 65 feet in diameter and the quadriga above the large porch towards the river is 75 feet high. Above the dome is a huge American eagle with outstretched wings, and the four corners of the main square of the building each supports an eagle. Under the arch of the imposing quadriga with its fine group, stands the equestrian statue of Washington. The exterior surfaces of the building are handsomely ornamented, and the dome has a profusion of gilding that catches the sunlight very effectively. The building itself and the adjacent approaches are liberally set with big American flags, which stand out in excellent relief against the white and gilt walls and dome.

The central interior space of the building is quite clear, and the various rooms in the four floors are most skilfully disposed so as to utilize the sides of the square and basement without in any way detracting from the architectural effect, either interior or exterior. Some of the side rooms have been specially furnished by States, such as New York, Massachusetts and California. There are two Otis electric elevators on the quadriga side run by a small power plant driven by gas engine, with current at 220 volts, one elevator taking 85 amperes and the other 45 amperes. One of these elevators runs from the basement, the other from the first floor. The wire for the building is all rubber covered, and was furnished by the American Steel & Wire Company. All told, there are about 700 incandescent lamps of 16 candle-power inside, and 1000 of 10 candle-power outside, of Packard and Columbia makes, those inside being frosted and those outside of clear glass. In the basement, where there is a comfortable American restaurant, four Adams-Bagnall enclosed arcs are used, of 6 amperes each. All the lighting is on the alternating three-phase system, and is fed through four Lahmeyer transformers of 20 kilowatts each, situated in a snug transformer pit under the front stoop.

All the fixtures inside the building were supplied by Oxley & Enos, and are fitted with Packard 16-cp lamps. The side brackets are for small clusters, but there are a good number of lamps in the big central crystal chandelier, held by a massive chain. The chandelier consists in reality of two groups, 30 lamps in the ball and 18 above the glass shield. The inner dome has also some 40 lamps concealed so as to throw light upward and illuminate the frescoed American flag. Outside the building, there are, as already stated, about 1000 lights, all held by special Pass & Seymour weatherproof and waterproof sockets of admirable construction, ensuring a continuity of the line of light. On the dome itself there are some 600 lamps in 8 vertical lines between the gilt panels and in the two defining circles, top and bottom, and there are also about 400 around the cornices at the water front and on the Rue des Nations side. Under the swooping eagle that surmounts the dome, there are 40 incandescent lamps, with half silvered reflectors throwing their light upward on the bird of freedom, and elucidating the fact that he has claws as well as wings. All the switches around the building, and the distributing boards, are of Crouse-Hinds construction, and elicit many compliments from European critics as to their finish, flexibility of control and careful guard against possibilities of interruption. The building is connected telephonically with the special American system worked out by Director Drake, and has within its walls a complete American post office. In France, posts and telegraphs go together under government control, but not in America, and it has been one of the standing jokes of the situation to inquire of the United States directors of electricity and transportation as to which of them was really in charge of the United States post office exhibit.

The electrical work on the United States Building has been in charge of Mr. W. D. Ball, chief of construction, who has also supervised the placing of some 500 Packard lamps on the American Court of Honor in the Electricity Building and of some 3000 in the United States Varied Industries section on the Esplanade des Invalides. These, with the ground floor space in Electricity Building, with between 50 and 60 Western Electric enclosed arcs, are all the façades and sections to be open to the public view at night. The architect of the building is Mr. Charles A. Coolidge, who is to be congratulated upon his work, but there have been a variety of suggestions as to how it might have been done differently, ranging from wigwams or Alaska huts with totems, to modern thirty-story buildings. The last would certainly have attracted attention in Europe, where church steeples are still the highest points in the line of vision in any city.

On May 15, the American Machinery Building at the Bois de Vincennes was opened with considerable ceremony, and in various ways

the event attracted great attention. It was the first inauguration of any kind out at that distant spot, by any country, and was ready and waiting the previous week, but it was deemed appropriate to open the National Pavilion first, so that the date first selected, May 10, was postponed. These facts may not sound very impressive, but under the circumstances and difficulties, they reflect infinite credit upon Director

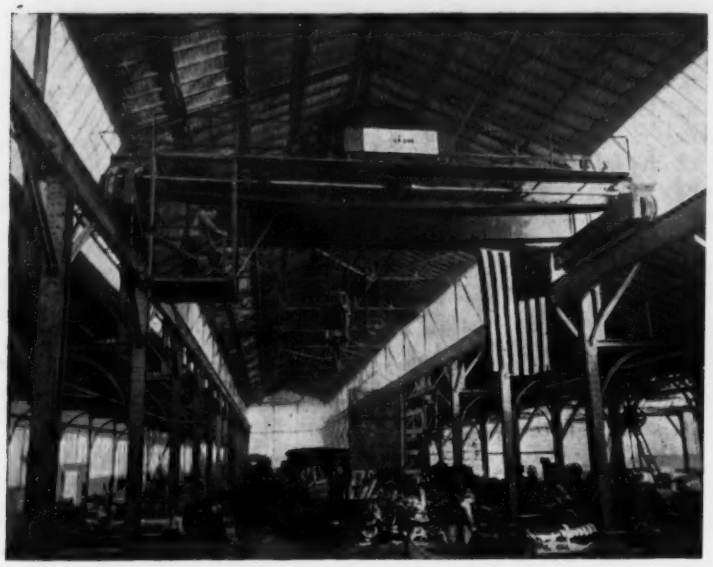

FIG. 2.—SHAW ELECTRIC CRANE, AMERICAN MACHINERY HALL.

F. E. Drake and upon the exhibitors, whose evidence of the resourcefulness of American engineers and mechanics has profoundly gratified every son of a whittling Yankee over here. Machines were lost at sea, others were smashed in transit, some parts did not arrive because of delays at Havre, while many another got by mistake up into the Champ de Mars; but on Tuesday last, with the aid of steam, electricity and compressed air, the whole thing moved off with the most perfect serenity, although it was worth a trip around some of the exhibits to see the devices resorted to in order to offset shortcomings such at those hinted at.

A large party embarked by special invitation on La Touriste on Tuesday afternoon, with Sousa's Band, serenaded the National Pavilion en route, and took stages to the grounds on reaching the Vincennes river pier. Many people also used the new Thomson-Houston trolley line from the river up to the park, and put in operation this week without any flourish, but in time to be a genuine boon to all visitors taking the river route; just as the other Thomson-Houston line from the Bastile is the only decent land route. The opening exercises were very brief. At one end of the building several thousand people crowded together in an open space, the only platform being that for the band. Elbow room having been cleared by a detachment of the American Guard, Mr. Drake tendered the

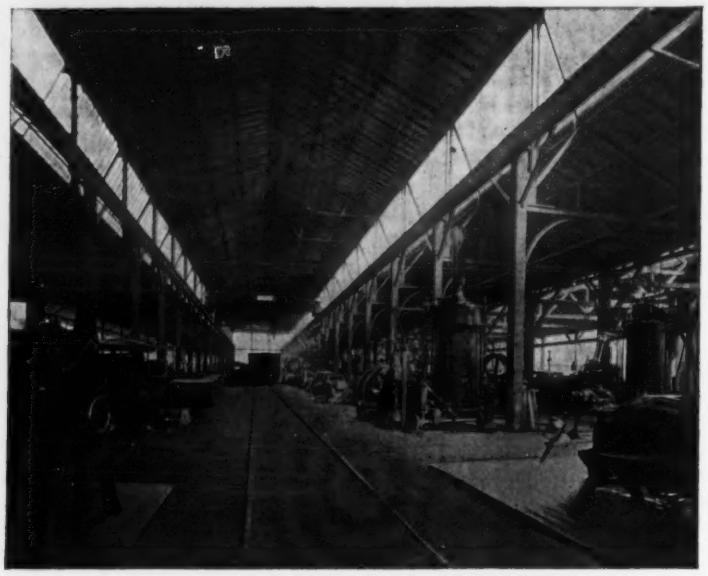

FIG. 4.—MAIN AISLE, AMERICAN MACHINERY HALL, VINCENNES.

building to Commissioner-General Peck, and said that he wished to pay full tribute to the firms and individuals who by their energy, enterprise and patriotism had contributed so generously to the completion of the work. He named especially the Carnegie Steel Company, the Berlin Iron Bridge Company, the Clonbrock Boiler Company, the Ball Engine Company, the Bullock Electric Manufacturing Company and the Shaw Electric Crane Company. He also paid a fitting compliment to the other hard-working exhibitors and to his own staff.

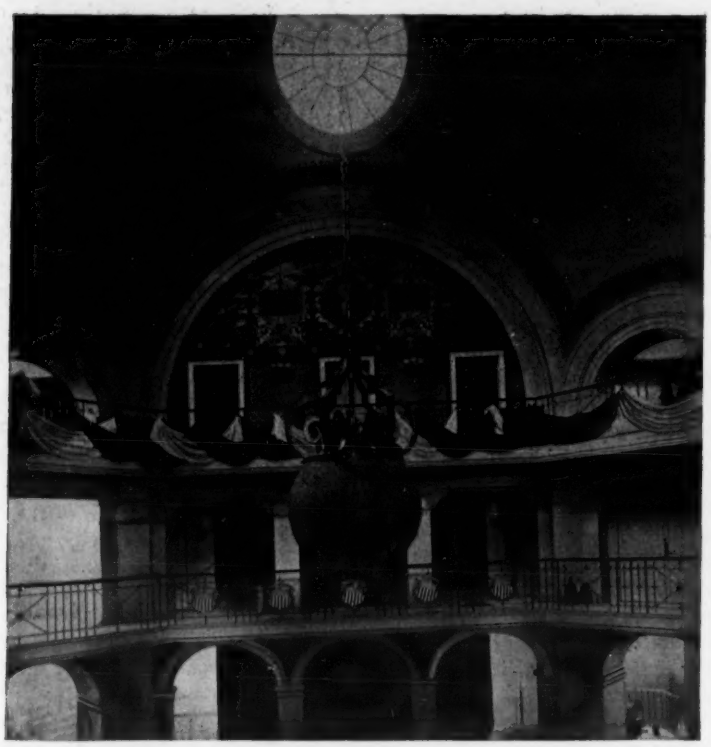

FIG. 3.—ELECTROLIER IN CRYSTAL, DOME UNITED STATES PAVILION.

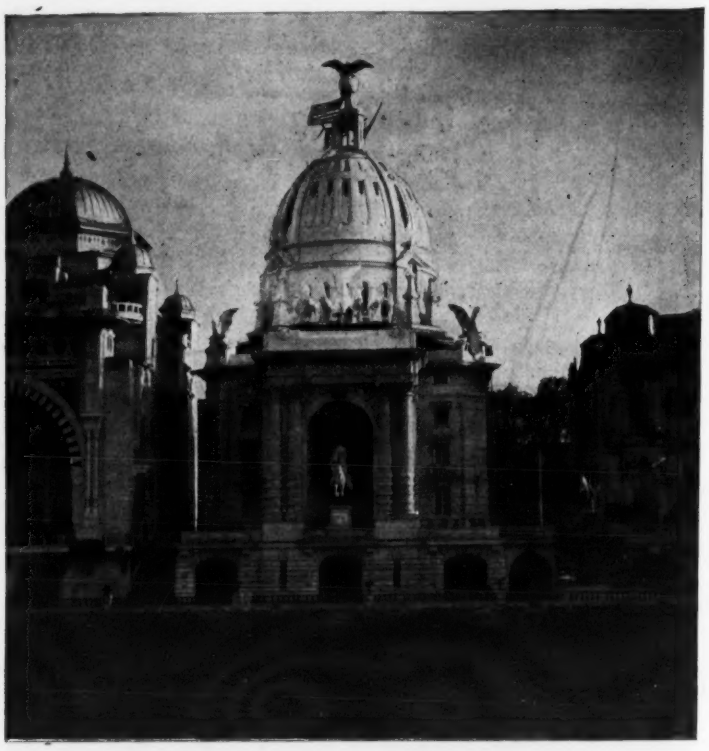

FIG. 5.—UNITED STATES NATIONAL PAVILION, RUE DES NATIONS.

The Commissioner General in accepting the building remarked that they had had many battles at the Exposition on behalf of the United States, but no struggle had been so severe as that to add space to the area for manufacturers and the department of mechanics. Mr. Drake was entitled to the credit of having met the difficulty by adding to the limited space on the Champ de Mars the splendid building and exhibit opened that day. Permission for it was obtained not easily from the French authorities, and the patriotic machinery manufac-

turers of the United States did the rest. They contributed out of their liberality, for the glory of the flag and the extension of American trade abroad, the means which had erected that fine edifice where they stood, and had installed all the machinery. Our common country was to be heartily congratulated on the enterprise, generosity and public spirit thus evinced. M. Masson Detourbet, the well-known French architect, charged with supervision of the foreign sections of the Exposition, then paid a high tribute to American genius in electricity and mechanics as there exemplified; and General Porter, American Minister, closed the oratory with the remark that in opening this typically American exhibit they were all participating in an event of historic and international importance from which great results would spring. The Commissioner-General then declared the building open, the steam whistles of the power plant blew, the band started playing and the crowd swarmed in, while all the machinery got into motion with a rush. It may be stated that on the way back the special boat stopped in the Seine opposite the German national pavilion, inaugurated that day, and to the delight of the people massed there the band played the "Wacht am Rhein" and other German airs. This courtesy not only was greatly appreciated, but the universal comment on it did not a little to help advertise the fact that an American machinery exhibit had also been opened that day.

The building itself has been frequently referred to in these columns as a proposed plan and in the earlier stages of its construction. It is 347 ft. long and 125 ft. at its greatest width, with a power plan wing. It has a main bay the whole length, with two side aisles, and as it stands is a fine specimen of steel frame construction and of the work of the Berlin Iron Bridge Company, who had the entire construction contract. It contains an area of 45,000 square feet, over which some 125 complete exhibits are spread. A 30-ton crane built by the Shaw Electric Crane Company travels the whole length of the main bay, and, as soon as ready, proved of great service in getting exhibits into shape. There were also available regular tracks and transverse tracks for the delivery of apparatus right at any space. The general plan of the building was laid out by Mr. Drake and designed by Mr. E. Jorgensen. The superintendent of the building is Mr. E. C. White, to whom thanks are due for courtesies extended this journal.

As is well known, part of the power plant for the building went down in the Pauillac, whereupon the French Westinghouse Company, through Messrs. Schmid and Coster, came promptly to the rescue with a temporary equipment from their Havre works. The steam plant consists of two 250-hp Morrin upright Climax boilers supplied by the Clonbrock Company, and the generating unit, when complete, is intended to consist of a 300-hp tandem-compound engine from the Ball Engine Company, of Erie, Pa., now in situ, and a direct-connected 250-kw generator from the Bullock Electric Manufacturing Company, although the machine substituted for that lost at sea may not be exactly of the same capacity.

The power plant is intended for power purposes specifically, rather than for lighting, it being the intention to open the part of the Exposition at the Bois de Vincennes only in the daytime. A great feature of the work is the distribution of this power by means of electric motors and compressed air. The motors are so numerous, varied and interesting in their application as to require full and separate treatment in a later article. All told, there are between 30 and 40 of them, most of which have already gone into operation, and they illustrate all the different ways in which motors can be applied directly to machines and tools, or indirectly by means of shafting. The total capacity of the motors is upwards of 400 horse-power or more than the capacity of the power plant, but here again the efficiency of electrical transmission comes in, the requirement of current always being far below that figure, even should all be running. Some of the units are quite large, one of 50 horse-power driving a cotton compress and another of 80 horse power taking care of a large exhibit of woodworking machinery, and being placed under the floor.

The admirable compressed air plant is in its way not less interesting, even to electrical engineers. On behalf of the Ingersoll-Sergeant Drill Company, Mr. J. J. Swalm has installed a cross-compound Corliss compressor and a smaller "Straight Line" compressor. These connect with a reservoir into which they can compress over 1000 cubic feet of free air per minute up to 100 pounds pressure. Within the building a branch service delivers this air to a number of exhibitors with pneumatic tools or machines requiring it, and to the oil-distributing system of the Ball engine, while the company also uses part of it in its own space. The main pipe line runs nearly a thousand feet across the grounds to the Transportation Building, where it delivers air to the American section for locomotives, air brakes, pneumatic signals, etc., there shown.

The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City—VIII.

By J. E. WOODBRIDGE.

(Concluded.)

THE ROTARY CONVERTERS.

The rotaries themselves are 14-pole machines, each rated at 990-kw. This figure, 1 per cent less than 1000-kw, is derived from the current output, 1800 amperes, multiplied by the rated pressure of 550 volts. The machines, however, can deliver a considerably higher voltage and a great deal more current, even up to a 100 per cent overload for short intervals.

Views of these machines are shown in Figs. 30 and 31, and dimensioned drawings in Fig. 32. Their armatures are bar-wound in 24 slots per pole, there being four bars per slot and 48 coils and commutator segments per pole. The fields are compound wound, the original intention having been to obtain regulation and over-compounding by means of reactances in the alternating-current circuits and variable excitation of the rotaries to give leading and lagging currents and consequent boosting and depressing reaction of the alternating voltage. These reactances were to have been located in part in the low-tension alternating-current six-phase leads from the transformers to the rotaries and in part in the high-tension feeders at the outgoing end in the power station. At this point the reactances would serve the double purpose of aiding regulation and of limiting the output in case of any feeder being short circuited. The rotaries have been up to the present working shunt, the series coils being out of service, and it has been found that the regulation is so good that the series fields and reactances are not needed. The batteries absorb the momentary fluctuations of the load and the generating capacity of the system is so great with such small drops between stations that constant potential is obtained without compounding. On this account no reactances have as yet been cut into the circuits, though they may be later if found desirable either for regulation or protection of the bus-bars against feeder shorts.

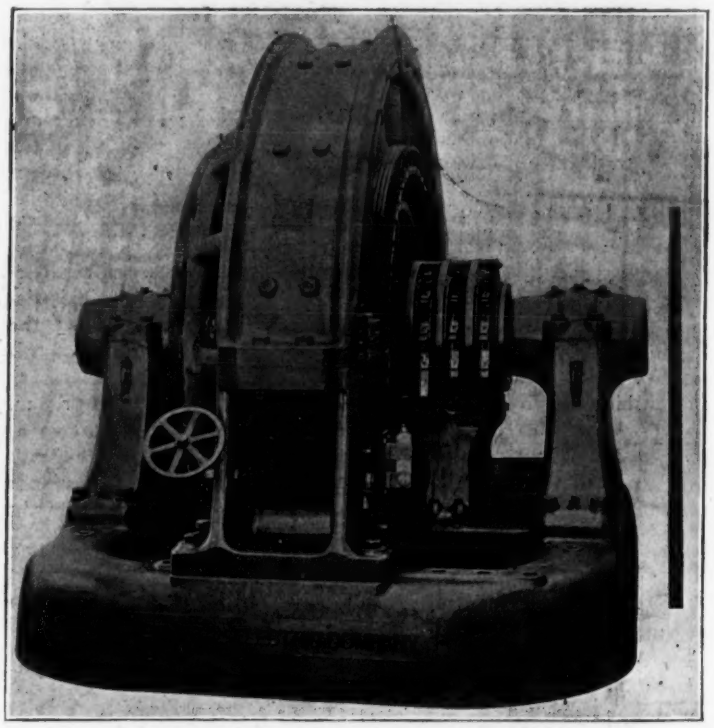

FIG. 30.—990-KW CONVERTER, SHOWING COLLECTOR RINGS.

While it is intended to start the rotaries regularly by means of direct current from other machines or the storage battery with which each sub-station is equipped, the machines are fitted with break-up switches in the field windings to divide the shunt coils into five electrically separate circuits and to open the shunt around the series field. These switches are opened when the machines are shut down, so that in case the alternating-current supply is accidentally turned into the armature at standstill the alternating magnetism set up in the field structure will not set up a sufficiently high electromotive force to

break down the insulation of the shunt field winding or will not burn out the shunt across the series field.

To reduce any tendency to hunt or pump there are inserted under the pole tips copper tongues, the eddy currents in which and in the solid steel of the poles check any tendency of the pole flux to sweep from tip to tip. These copper tongues are wedged between the pole tips by the very simple bolt and tightening nuts shown in Fig. 33. There are mounted on the ends of the shafts of the rotaries the usual

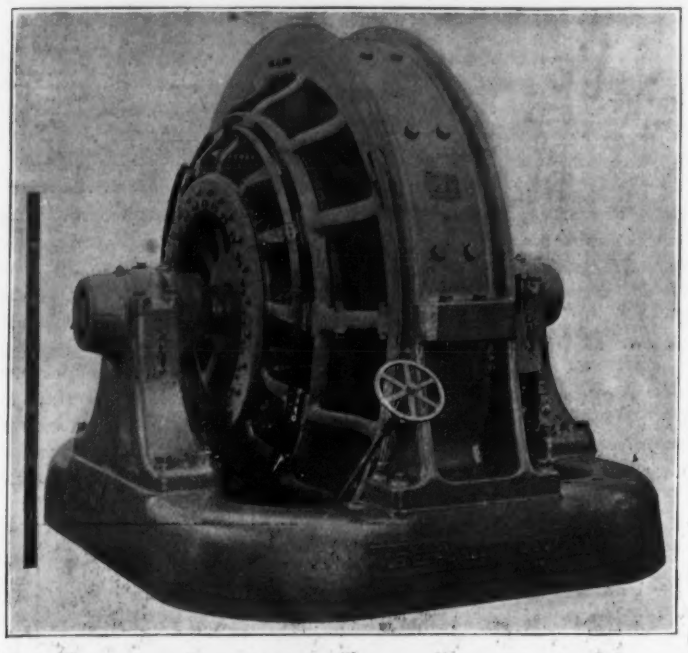

FIG. 31.—990-KW CONVERTER, SHOWING COMMUTATOR.

oscillators or end-play devices to prevent the brushes from wearing tracks in the commutators and collector rings.

It was originally planned to fit each rotary with a centrifugal device intended to prevent the machine from running away. This device, as planned, was to consist of an auxiliary magnet above the tripping coil on the direct-current circuit breaker, the circuit of this magnet and a battery being closed through a switch on the rotary shaft, which switch was to open in case the normal speed of 214 r.p.m. were materially exceeded. This magnet was to be arranged so as to drop a weight on the armature of the tripping coil of the circuit breaker, operating the trip. This was intended for use in case the alternating-current supply of the rotaries should be cut off by the

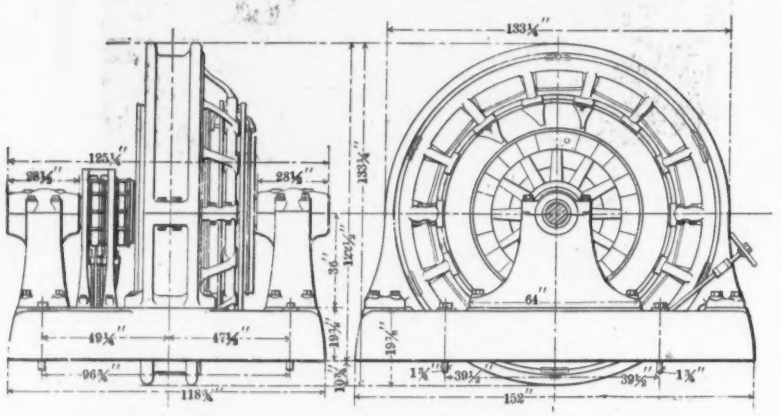

FIG. 32.—END AND SIDE ELEVATIONS OF 990-KW CONVERTER.

automatic relays attached to the oil circuit breakers already described, or by other causes, the direct-current circuits of the rotaries remaining closed. In this event the storage battery of the station would tend to drive the rotaries as direct-current motors, but the storage-battery current would come in through the series fields of the rotaries in a direction the reverse of normal, weakening the field strength of the rotaries, causing them to speed up and take more current and still further weaken their fields, and so on until an excessive speed would be attained. If the rotaries continue to be worked as shunt machines there will be no danger of this action.

Each rotary weighs about 45 tons, of which the armature weighs approximately 16 tons. One of these rotary converters was found on test to give the following efficiencies from the alternating-current input to the direct-current output:

Double load	96.8 per cent.
Full load	96.0 per cent.
Half-load	93.6 per cent.

THE DIRECT-CURRENT CIRCUITS.

The sub-station direct-current switchboards are made up of standard railway panels with a few modifications of the generator panels to adapt them to rotary converters instead of mechanically-driven generators. These modifications are shown in the diagram of sub-station connections as well as in the elevation of the board with circuits, Fig. 27. It may be seen that there is provided on the base of the station panel a rheostat switch connected to a starting box for starting any one of the rotaries. This rheostat switch is connected to double-throw switches on the bases of the machine panels, as indicated in the diagram, in such a way that throwing up any one of these double-throw switches—the others remaining down—connects the starting box around the negative main switch of the corresponding rotary. By closing the positive switch and the circuit breaker a path is made through the armature of the machine in series with the starting box through which current passes for starting the rotary as a direct-current motor. When it is up to speed it is synchronized in the usual way, and the two oil circuit breakers between the corresponding group of step-down transformers and the bus-bars are closed, throwing the machine in circuit on the alternating-current end. The controlling switch of one of the two oil circuit breakers (the one fitted with automatic overload release) is on the alternating-current switchboard. This switch is closed before synchronizing. The controlling switch of the other oil circuit breaker is on the direct-current panel, where it may be conveniently closed as soon as the machine reaches synchronism. The field is separately excited from the bus-bars while the machine is being brought up to speed as a motor; a separate field switch being provided which, when the machine is

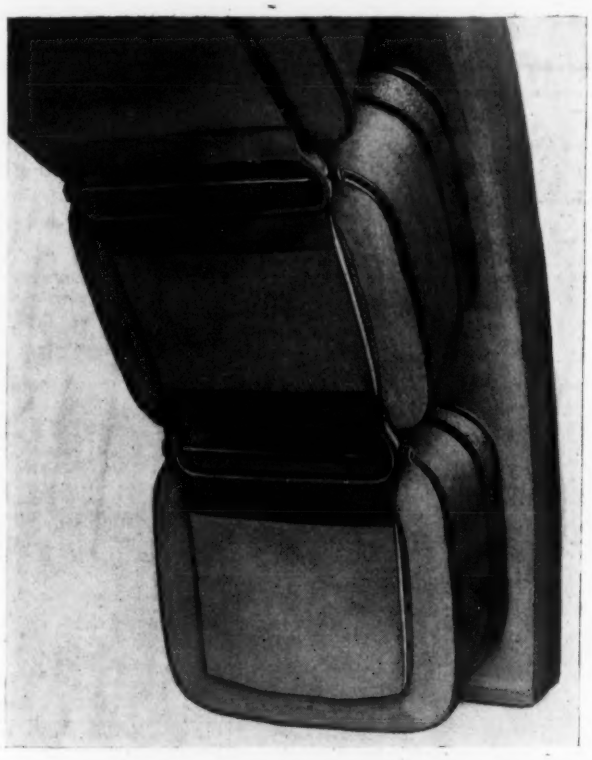

FIG. 33.—COPPER STRIPS UNDER POLE TIPS TO PREVENT HUNTING.

across the direct-current buses, can be moved to make the machine self-exciting, so that when the machine is again thrown out of circuit by the main switches the field is in shunt with the armature and not across the bus-bars. This special field switch passes across from the bus-exciting to the self-exciting position, or vice versa, without opening the field circuit. It therefore temporarily short circuits the negative main switch while passing from one position to the other. It should therefore only be moved when the negative main switch is closed or when the machine is entirely cut off on both polarities.

Another unusual device in connection with these machines is an

ammeter reverser, which is designed to reverse the connections between the ammeter shunt and the ammeter when the machine is being started, so that the starting current will be indicated on the main ammeter. The reverser is operated by a push plug under the negative main switch. As the machine is started with the negative main switch open, the plug remains projecting from the face of the board, connecting the ammeter to the shunt in such a way as to indicate properly the starting current which is, of course in the opposite direction from the current delivered normally. As soon as the negative main switch is closed it pushes the plug in and reverses the connection between the ammeter and the shunt so that the working current delivered by the rotary to the bus-bars moves the ammeter needle in the right direction.

As many engineers have expressed the opinion that in a system with as heavy and as concentrated loads as this one, several separate generating stations of the usual direct-current type would be preferable to the polyphase central generating plant and its accompanying sub-stations, it may be interesting to note what efficiency can be expected. The rotary converters have, as noted above, shown under test a full load efficiency of 96 per cent. The step-down transformers give an efficiency of over 98 per cent under full load. The combined efficiency of the two is therefore about 94 per cent under rated load. Allowing 1½ per cent loss in the high-tension feeders from the generating station to the sub-stations, and a further loss of one-half of 1 per cent in the sub-station auxiliaries, such as the blowers, reactive coils, motor generator, air pumps, etc., exclusive of the battery and battery booster, the efficiency between the generators and the direct-current switchboard comes out about 92 per cent under full load. By means of the batteries and differential boosters the load upon the rotaries and step-down transformers will be constantly maintained close to the full rated load of the number of machines connected. Thus the all-day efficiency between the switchboard of the generating station and the direct-current switchboards of the sub-stations can be easily maintained above 90 per cent.

It is difficult in the case of an installation as extensive and varied as this one to give credit where credit belongs without giving the names of a large part of the engineering staff of the builders, in this case the General Electric Company. The work as a whole was carried out under the general supervision of Mr. E. W. Rice, Jr., the head of the engineering department, who also designed the oil circuit breakers, the double-delta connection and took an active part in the layout of the establishment, many of the plans for insuring safety being carried out at his instance. The many special switchboard and circuit problems, including the details of several alternative propositions that were not adopted, were worked out by Mr. E. M. Hewlett, engineer of the switchboard engineering department, and his assistants. The generators were designed by Mr. H. J. Reist from preliminary calculations of Messrs. C. P. Steinmetz and Ernst J. Berg. The rotary converters and exciters were designed by Mr. H. F. T. Erben, and the transformers by Mr. W. S. Moody. The installation of the apparatus is in itself by no means an insignificant part of the whole contract. This branch of the work was under the charge of Mr. T. F. Mullaney assisted by Mr. T. H. Soren.

On the part of the Street Railway Company, the original specifications were drawn up by Mr. F. S. Pearson, consulting engineer, and the work was done under the supervision of Mr. M. G. Starrett, chief engineer, who was assisted in the electrical work by Mr. Walter A. Pearson, electrical engineer.

The completion and operation of this great station will be watched with interest not only by engineers but by the leaders of finance who control lighting and traction properties throughout the country and who are rapidly bringing these properties together financially in consolidated systems. A plant like that described above gives a means of producing the power required for operating together the lighting, traction and general power distribution systems of a large city scattered over many square miles at the lowest cost per unit output of any known means of electric power production attainable in most locations.

Proposed Canadian Water Power.

Mr. E. S. Jenison, of Port Arthur, Ont., proposes a scheme to generate 60,000 horse-power from the Kakaboka Falls, near Port Arthur. Mr. Jenison intends developing 10,000 horse-power at the start, and has recently been to New York getting estimates. He will follow this 10,000 horse-power by other blocks until the whole 60,000 horse-power are developed.

The Jacques-Cartier Water Power Company.

THE International Hydraulic Company recently completed the plant for the Jacques-Cartier Water Power Company, of which mention has several times been made in these columns. The power station is situated at St. Gabriel, P. Q., where there is a fall of 20 ft. in the St. Gabriel River, which occurs in a rapid, 200 yards in length. At the head of the rapids a dam 300 ft. in length, of substantial foundations and abutments, has been constructed. The power house stands in a depression near the river, 270 ft. below the dam, the water being conveyed by two penstocks 13 ft. in diameter.

An interior view of the generating room is shown in Fig. 2. It contains two 750-kw Westinghouse three-phase alternating-current generators direct-connected to S. Morgan Smith water wheels. The generators are wound for 2000 volts, with a frequency of 7200 alternations at a speed of 150 r. p. m. Between the two generating units are seen two exciter units, 37½-kw Westinghouse multipolar generators of 125 volts, direct-connected to smaller water wheels running at 350 r. p. m. The switchboard consists of two generator panels, two circuit panels and one exciter panel, and is mounted on a gallery standing against a partition running the full length of the building, directly in the centre of the power house, so that the switchboard is placed very

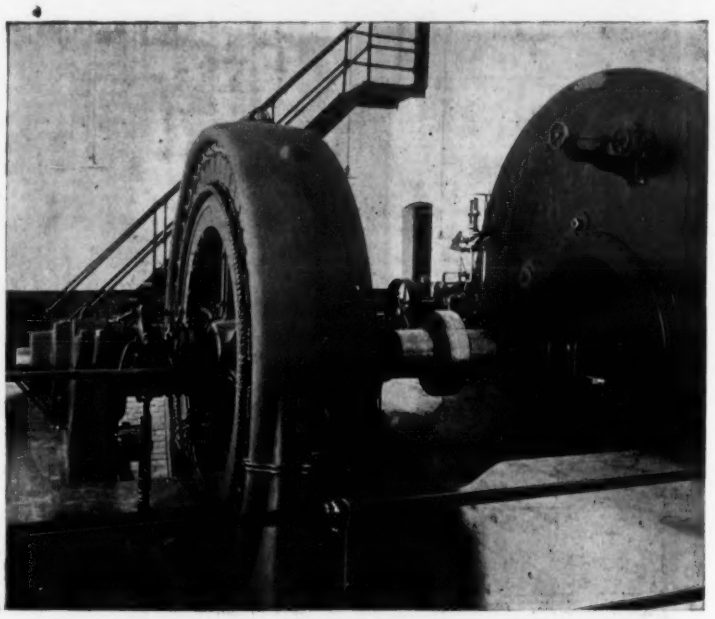

FIG. 1.—SHOWING 750-KW THREE-PHASE GENERATOR DIRECT CONNECTED TO WATER WHEEL.

favorably for connection with the generators and exciters. Should water gather in the generator pits, either from leakage of water wheel cases or from condensation, it is removed by a rotary pump, driven by a belt from the shaft of one of the exciters.

Upon the opposite side of the partition is a space 24 ft. 10 ins. in depth, extending the whole length of the building, which is divided into three floors. The lowest contains the water wheels and their appurtenances; the first floor, which can be entered by steps from the switchboard gallery, is divided into several rooms. One contains six 250-kw Westinghouse self-cooling, oil-insulated transformers, which step-up the 2000-volt generated current to 20,000 volts three-phase at a frequency of 60 cycles per second. The six raising transformers are arranged in delta connections of three each, so that, if desired, one transformer may be cut out without interrupting the operation of the other two, which will continue to supply three-phase currents to the lines. The other rooms are the apartments of the employees of the company, there being three bedrooms, a dining room, kitchen and bathroom. In the attic are the Wurts lightning arrester choke coils and the high-potential circuit breakers.

The electric energy is transmitted to Quebec, 18 miles distant, the sub-station being situated near the St. Valier tollgate immediately outside the city limits. This building, 15 ft. square, has been specially constructed, and is built of brick. The transmission lines are carried on poles from the generating station at St. Gabriel, and enter the sub-station at the top, passing to Wurts lightning arrester choke coils and thence to the high-potential circuit breakers and step-down transformers, which reduce the current to 2200 volts. From the sub-sta-

tion a 2200-volt current is conveyed by two two-phase conductors to a distributing switchboard, about one mile distant, in the heart of the city of Quebec, and thence is redistributed to other transformers which reduce the current to 220 volts, delivering to a three-wire system which radiates throughout the city. At the distributing switchboard are regulators to control the voltage on the 2200-volt feeders. If too heavy a load occurs on one of the feeders, causing a drop in voltage, by means of the regulator it is raised to a normal point. The voltage at various points on the secondary network of wires is shown on a voltmeter at the distributing switchboard, pressure wires being used for the purpose.

The entire plant is in duplicate, each half being complete in itself, but also capable of being worked in parallel with the other half. Each set of water wheels, generator, exciter and transformers form two separate, but complete systems. The transmission line is also constructed in two complete circuits, each having three wires for three-phase transmission, with the three wires of each circuit spaced 18 ins. from each other. This arrangement enables either or both halves of the system to be run at will.

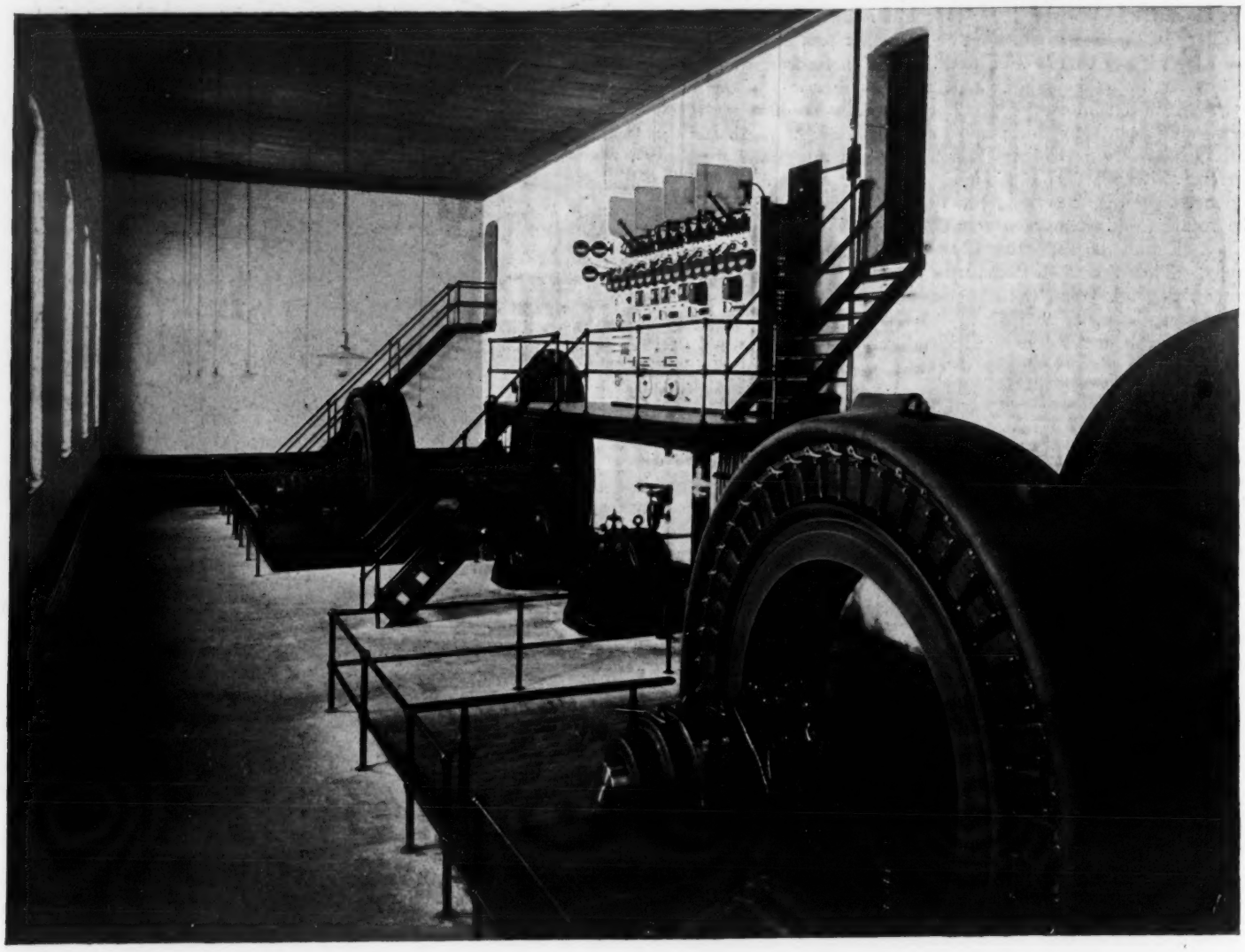

FIG. 2.—INTERIOR OF POWER HOUSE, JACQUES-CARTIER WATER POWER COMPANY.

The first illustration, Fig. 1, shows one of the 750-kw generators and its connection with its corresponding water wheel.

Since the plant commenced operations in February last over 7000 lights have been wired, and there is every probability that the full output of the plant will soon be appropriated. The charges for current are extremely low, about one-half of the rates usual in this country. A flat rate is made of one cent per lamp per day, or current is charged at half a cent per lamp of 16 candle-power per hour. The running expenses of this water power plant are so reasonable that it is remunerative even at the low rates charged for current. The power station is operated by four men, two being on duty by day and two at night. The wages account, we are informed, do not exceed $250 per month. The entire electrical equipment was designed and carried out by the Westinghouse Electric & Manufacturing Company.

Central Stations in the South—I.

BY W. S. KEY.

MONTGOMERY LIGHT & POWER COMPANY.

THE Montgomery Light & Power Company, which has the field all to itself in the city of Montgomery, the capital of the State of Alabama, does one of the largest businesses in the furnishing of light and power of any company in the South.

Not only does it generate electricity for illuminating the city streets, State Capitol and all other executive buildings, commercial houses and private dwellings, but it also furnishes power for the two electric street railway companies which operate in this wide-awake and attractive city; at the same time it owns and operates the gas works as well, from the latter supplying millions of feet of gas per annum for both illuminating and heating purposes. In a sense, this company enjoys what is practically a monopoly, and renders an efficient service to both the city and its citizens. Its plant is one of the best equipped and most up-to-date in the South, and possessing such facilities, it is not to be wondered at that at the present time it holds contracts for service which represent nearly the sum total of all the lighting and power business that is possible in the city.

As a full description of its gas plant would not come quite within the province of the ELECTRICAL WORLD AND ENGINEER, it may be stated in reference to that department of its flourishing business, that the plant was erected only a very few years ago and is throughout of the most modern type in every detail. It includes a complete set of apparatus for the manufacture of both coal and water gas; that there is a good demand for both, and being not far distant from the bituminous coal fields of Alabama, the company is enabled to supply gas, whether for lighting or fuel purposes, at figures which induce a very large consumption.

The electric branch of its business, however, is by far the more extensive. Incidentally it may be stated as a historic fact that it was in this city Mr. C. J. Vandepoele, the versatile pioneer electrical inventor, made many of his earliest experiments with his trolley system of street-car propulsion. It was here he both encountered and overcame the innumerable obstacles that presented themselves in the path of successful electric motor development, and laid the foundation for that phenomenal growth and expansion w[illegible] become the wonder of the nineteenth century. And the experimental roads operated in the early eighties have expanded into an extensive system of city and suburban car service, that is not the least interesting feature in this prosperous and quondam capital of the Confederate States. What is also interesting is the further fact that the road to-day is under the careful and competent management of one of Mr. Vandepoele's assistants, who remembers all the troubles of the early days, and by his skill has been enabled to completely provide against their recurrence.

INTERIOR VIEW OF MONTGOMERY LIGHT & POWER COMPANY'S CENTRAL STATION.

The Light & Power Company's central station is located in the northeast part of the city, about 4000 ft. from the centre of distribution, and close to the tracks of the main lines of the Atlanta & West Point and Western of Alabama Railroads. The station was erected in 1892, and is built throughout of brick with brick foundations, having a Georgian pine roof covered with "Rubberoid," which stands the climate exceedingly well. The general dimensions of the station are 123 ft. x 94 ft.; engine and generator room, 56 ft. x 132 ft.; boiler room, 36 ft. x 80 ft.; coal storage room, 32 ft. x 50 ft. The chimney stack is of Birmingham steel 187 ft. high, and self-supporting, having a flue 9 ft. 6 ins. diameter.

The engines are all of the Hamilton-Corliss type, of the following capacities: One 42-in. x 20-in., one 24-in. x 48-in. and one 32-in. x 48-in., the latter heavy-duty type. A line of shafting 6-in. and 7-in. diameter and 125 ft. long extends the length of the engine room, and is equipped with Hill clutches, idlers and split-clutch pulleys throughout. Each engine is belted with a three-ply 60-in. belt made by the Chicago Belting Company.

The boiler equipment includes six 2000-hp Heine safety-tube boilers, having three furnaces each; one Goubert heater of 2000 horse-power and three separators. The coal storage room holds 500 tons of coal. Throughout the station Chapman high-pressure valves are used exclusively, and two Worthington duplex pump[illegible] tion is provided with an underground tank in which are stored 5000 gallons of water. In the summer time water is taken from a neighboring ice factory at an average temperature of about 115 degrees, which is found to be a very economical arrangement in the operation of the station.

The generating plant consists of five D. 62 G. E. generators and one 100-kw Westinghouse machine. As current for the entire city and commercial lighting is generated in this station .there is an extensive system of lighting apparatus, in addition to that for the railway system.

A Westinghouse air compressor of the type used on the air-brake has been installed for use in cleaning the dynamos and generators at periodic times. By means of a piece of rubber hose attached to the compressor, all the dust is blown from the inside of the various machines, so that the man in charge has little or no difficulty in keeping every machine spotlessly clean and free from injurious substances.

The lighting apparatus includes three 150-kw, 2300 volts G. E. monocyclic type; three 6.6 ampere Brush arc machines of 120 lights each; one 9.6 ampere Brush machine of 80 lights. There is also one

110-kw, 350-volt power generator of the G. E. type. The exciters used are of the Westinghouse type.

The switchboard for the railway generators is a skeleton frame of yellow pine, and is equipped with every modern appliance, including circuit breakers, fuse boxes, lightning arresters, voltmeters and ammeters.

The switchboards for the lighting service are of special type designed and built for this plant. The one for the incandescent lamp service is of blue Vermont marble, having four panels and subpanels 9 ft. 6 ins. high, there being one panel for each circuit and one for each of the two feeder circuits. These various circuits are subdivided at the centre of distribution in the city. Each circuit on the switchboard is provided with circuit breakers and fuse blocks, all the high-tension current wires being connected with the back of the board. The lightning arresters are of the Wurts non-arcing type on the incandescent switchboard, while T.-H. arresters alone are used on the arc-light switchboard. The latter is of enameled slate of the standard twelve-circuit Brush type, and is equipped with every modern device called for in switchboard service, including on each panel one Thomson ammeter for feeder circuit; one for teaser circuit, and one for generator circuit. One Thomson voltmeter; one compounding rheostat for varying the percentage of compounding on the generators; rheostats for exciters and one double-throw switch.

The system of grounding the wires at this station is as follows. A large hole was dug several feet deep, and into this hole were placed several tons of old car wheels and scrap iron. The spaces between this accumulation was then filled in with small charcoal, of which a layer covers the entire heap of metal. Through the charcoal, strips of thin copper have been connected with the iron and extending to each of the lightning arresters in the station. This arrangement has always proved effective, and thus far no difficulty has been experienced.

The conductors used throughout the city are rubber-covered wire, while weatherproof wire is used for all inside work. The trolley wire is No. 0 hard-drawn copper, the feeders being No. 0000 insulated copper wire.

All the street arc lamps are of the Brush type, and of these there are in use 280 1200-cp and 50 2000-cp lamps. On commercial service there are 50 2000-cp Adams-Bagnall enclosed arc lamps, run on a regular series arc circuit; also 35 1200-cp Brush commercial lamps and 85 G. E. enclosed alternating arc lamps run on incandescent circuit. The company also furnishes current for at least 10,000 incandescent lamps used in the stores, offices and residences of the city. For power purposes, apart from the street railway service, about 50 horse-power is the average demand, there being some 20 motors used throughout the city, in addition to some 25 electric elevators in use, while in the summer season from 350 to 400 fan motors are in constant use.

The average daily output at this station is about 900 kilowatts, with a daily consumption of 25 tons of coal, which costs, delivered at the works, about $2.10 per ton. Whenever there happens anything of an unusually exciting character in the city, every car belonging to the two companies is impressed into service, while in ordinary times every one of the railway generators at the central station are kept running from 6 o'clock a. m. to 11 p. m. with no power in reserve. The Montgomery Street Railway owns 14½ miles of track on which it operates 31 cars, equipped with G. E. motors, the entire system being under the management of Mr. R. L. Scott, former assistant to Mr. Vandepoele. The Montgomery Suburban Railway Company owns four miles of track on which it operates 7 cars, all equipped with Westinghouse motors, the road being under the management of Mr. W. S. Jones.

Most of the contracts held by the Montgomery Light & Power Company, whether with the railroad companies, the State, the city or the general public, are for three years or more, and at present there is, as before stated, no opposition. The control of the company has changed hands from time to time, but to-day some solid local men are interested in the plant. The entire station is modern throughout and in first-class running shape. It is being carefully and efficiently managed, and with a continuance of the business it is now doing, a prosperous future awaits it. For the past three years the entire plant has been under the care of Mr. J. C. Dunham, a young Southerner, who received his technical training at the Alabama Polytechnic Institute, Auburn, Ala., the engineer being Mr. A. S. Lowrie, who has charge of the station proper, a view of the interior of which is shown on page 863.

Elements of Illumination—IV.

By Dr. Louis Bell.

THE effects of the selective absorption which so deceives the eye when colored objects are viewed in colored lights, are shown in a variety of ways according to the colors involved, but the net result of it all is to show the necessity of looking out for the color of artificial lights. Of course, a really strong color may produce very fantastic results. For example, in the rays of an ordinary green lantern, such as is used for railway signals, greens generally appear of nearly their natural hue; but greens, yellows, browns and grays all match pretty well, although they may appear darker or lighter in shade. Pink looks gray, drying in shade as it gets redder, and red is nearly black, for the green light which falls upon it is almost totally absorbed. Practical illuminants do not often present so violent deceptions, and yet gas or candle light is certain to change the apparent hue of any delicate colors containing bluish green, blue or violet rays. An old Welsbach mantle which gives a light of a distinctly greenish cast is pretty certain to queer the hue of everything not green upon which it falls. Incandescent electric lights affect colors in much the same way as brilliant gas light, while arc lights give a fair approximation to daylight. It by no means follows, however, that all colors should be matched by arc lights in preference to other sources of illumination. A match so made stands daylight, but may be most faulty when viewed by gaslight. If matching colors has to be done, it is a safe rule to match them by the kind of light by which they are intended to be viewed. Moreover, different shades of the same color are differently affected in artificial light. As a rule, deep full colors are far less affected than light tones of the same general hue. Clear yellows, reds and blues not verging on green are little altered, but pale pinks, violets and "robin's-egg" blues quite generally suffer. Very often when a color is not positively altered it is made to appear gray and muddy.

For while in a green light greens look particularly brilliant, red may be practically extinguished, absorbing all the rays which come to it, so that a deep red will be nearly black, and a very light red merely a dirty whitish, tinged with green if anything.

Quite apart from any effect of colored illumination, colors seem to change in very faint illumination. This is a purely physiological matter, the eye itself differing in its sensibility to different colored lights. In very faint illumination no color of any kind is perceptible—everything appears of uncertain shades of gray. As the light fades from its normal intensity, as in twilight, red disappears first, then violet and deep blue follow, settling like the red into murky blackness; then the bluish green and green shade off into rapidly darkening gray, and finally the yellow and yellowish orange lose their identity and merge into the night. At the same time the hues even of simple colors change, scarlet fading into orange, orange into yellow, and green into bluish green.

Obviously composite colors must vary widely under such circumstances, for as the light grows dimmer their various components do not fade in equal measure. Pinks, for instance, would turn bluish gray at a certain stage of illumination, owing to the extinction of the red rays. In fact, in a dim light the normal eye is color blind as regards red, and one can get a rather good idea of the sensations of the color blind by studying a set of tinted wools or slips of paper in the late twilight. The similarity of the conditions is strikingly illustrated in Fig. 6, which shows in No. 1 the distribution of luminosity in the spectrum of bright white light to the normal eye, and in No. 2 the luminosity of the same as seen by a red blind eye. No. 3 shows the luminosity of the spectrum when reduced to a very small intensity and seen by the normal eye. The data from Abney's experiments, and the intensity of No. 3 was such that the yellow component of the light corresponding to *D* of the spectrum was 1-165 candle-foot. The ordinates of No. 2 and No. 3 have been multiplied by such numbers as would bring their respective maxima to equal the maximum of No. 1, as the purpose is to show their relative shapes only. The "red-blind" curve No. 2 shows very faint luminosity in the scarlet and orange and absence of sensation in the crimson, while the maximum luminosity is in the greenish yellow. It is easy to see that the sensation of red is practically obliterated. But in No. 3 every trace of red is gone, and the maximum brilliancy has moved up into the clear green of the spectrum at the line *E*. With a still further reduction of intensity, the spectrum would fade into gray as just noted, while a slight increase of light would cause No. 3 to closely approximate No. 2.

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Starting with the normal curve of luminosity No. 1, the peak of the curve being one candle-power, the light at *B* would disappear if reduced to .01 of its initial value, that at *C* at about .0011, at *D* .00005, at *E* .0000065, at *F* .000015, and at *G* .0003.

Now the practical application of these facts is manifold. Not only do they explain the odd color effects at twilight and dawn, but it is worth noting that the cold greenish hue of moonlight on a clear night means simply the absence of the red and orange from one's perception of a very faint light, for dim moonlight is not much brighter ordinarily than the light of curve No. 3. For the same reason a red light fades out of sight rather quickly, so that a signal of that color is not visible at the distance when one of another color and equal brightness would be easily seen. Not only is the eye itself rather insensitive to red, but the luminosity of the red part of the spectrum of any light is rather weak, so that when the other rays are cut off by colored glass, the effective light is greatly reduced. About 87 per cent of the effective luminosity of white light lies between the lines *C* (scarlet) and *B* (deep green), the relative luminosities at various points being about as follows:

Line.	Luminosity.
B	3
C	20
D	98.5
E	50.
b	35
F	7
G	0.6

The luminosities of light transmitted through ordinary colored glasses of various colors is about as follows, following Abney's experiments, clear glass being 100:

Color of Glass.	Light Transmitted.
Ruby	13.1
Canary	82.0
Bottle green	10.6
Bright green (signal green No. 2)	19.4
Bluish green (signal green No. 1)	6.9
Cobalt blue	3.75

These figures emphasize the need of a very strong source of light if it is necessary to get a really bright-colored light. It is worth noting that red is really a bad color for danger signals on account of its

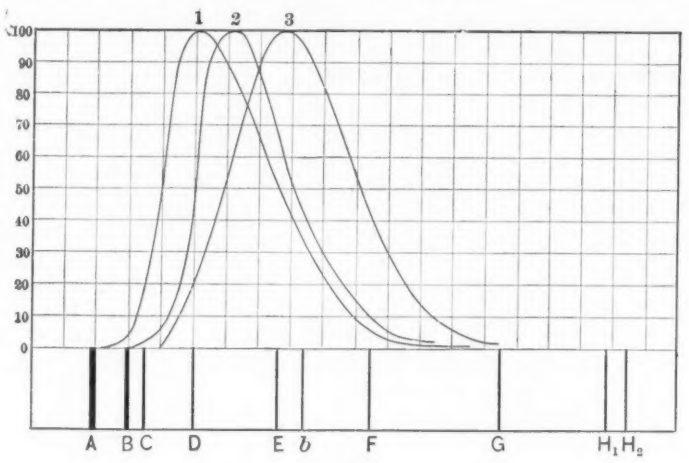


FIG. 6.

low luminous effect, and were it not for the danger of changing a universal custom, red should be the "clear" signal and green the danger signal, the latter giving a much brighter light, and thus being on the average more easily visible.

It is easy to see that any artificial illuminant is at a considerable disadvantage if at all strongly colored, for not only does a preponderance of red or green rays injure color perception, but the luminosity of such rays is rather low, and they do not compensate for their presence by giving greatly increased illumination.

Owing to this fact the effective illumination derived from various sources of light is pretty nearly proportional to the intensity of the *yellow* component of each. Crova has based on this rule an ingenious approximate method of comparing the total intensity of colored lights by comparing the intensities of their yellow rays either from their respective spectra or by sifting out all but the yellow and closely adjacent rays by means of a colored screen. Certainly for practical purposes the rays at the ends of the spectrum are not very useful. So far as the ordinary work of illumination goes, white or yellowish white light should be used, and the only practical function of strongly colored lights is for signaling and scenic illumination.

The general effect of strongly colored lights is to accentuate objects colored like the light and change or dim all others. Lights merely tinted produce a similar effect in a less degree. Bluish and greenish tinges in the light give a cold, hard hue to most objects, and produce on the face an unnatural pallor; in fact on the stage, they are used to give in effect the pallor of approaching dissolution. Naturally enough such light is unfitted for interior illumination, as aside from its effect on persons it makes a room look bare, chill and unfurnished. In a less degree a similar effect is produced by moonlight, which, from a clear sky, is distinctly hard and cold, the white light growing faintly greenish blue as its diminishing intensity causes the red to disappear.

On the other hand, a yellow-orange tinge in the light seems to soften and brighten an interior, giving an effect generally warm and cheery. This result is extremely well seen in stage fire-light effects. Strongly red light is, however, harsh and trying and particularly difficult to see well by, so that it should generally be carefully avoided.

While it is not easy to predict accurately the effect of tinted lights upon various delicate shades without a careful study of the light rays forming each, the average effects relating to the simpler colors are summarized in the following table. It is compiled from the experiments of the late M. Chevreul, for many years director of the dye works of the Gobelins tapestries. The colored lights were from sunlight sifted through colored glass, and the effects were upon fabrics dyed in plain, simple colors.

Original Color of Fabric	Color of Light Falling Upon Fabrics.					
	Red	Orange	Yellow	Green	Blue	Violet
Black	Purplish Black	Deep Maroon	Yellow-Olive	Greenish Brown	Blue-Black	Faint Violet Black
White	Red	Orange	Light Yellow	Green	Blue	Violet
Red	Intense Red	Scarlet	Orange	Brown	Violet	Red-violet Purple
Orange	Orange Red	Intense Orange	Yellow-Orange	Faint Yellow slightlyGreenish	Brown slightly Violet	Light Red
Yellow	Orange	Yellow-Orange	Orange-Yellow	Yellowish Green	Green	Brown tingedwith faint Red
Light Green	Reddish-Gray	Yellow-Green	Greenish Yellow	Intenser Green	Blue-Green	Light Purple
Deep Green	Reddish Black	Rusty Green	Yellowish Green	Intenser Green	Greenish Blue	
Light Blue	Violet	Orange-Gray	Yellowish Green	Green Blue	Vivid Blue	
Deep Blue		Gray, slightly on Orange	Green-Slate	Blue Green	Intenser Blue	Bright Blue-Violet
Indigo Blue		Orange-Maroon	Orange-Yellow (very dull)	Dull Green	Dark Blue-Indigo	Deep Blue-Violet
Violet	Purple	Red-Maroon	Yellow-Maroon	Bluish Green-Brown	Deep Bluish Violet	Deep Violet

The facts set forth in this table show well what should be avoided in colored illumination. As regards various shades of the same colors it must be remembered that light shades are merely the full deep ones diluted with white, which is itself affected by the color of the incident light. In a general way, therefore, one can use this table over a wider range than that written down. For instance, a very light red in blue light would look blue with a mere trace of violet, while in yellow light it would be bright yellow with very slight orange cast. Generally a very light color viewed by colored light will be between the effect produced on the full color, and that produced by the light on a white surface. Similarly a light only tinged with color will only slightly modify the tone of a colored object in the direction indicated for the full-colored light in the table. But delicate shades from modern dyestuffs, which often absorb the light in very erratic ways, are a different matter, and do not obey any simple laws. On the other hand, pure colors, in the sense in which the scarlet around the *C* line of the spectrum is pure, act in a fashion rather different from that shown in the table, which

pertains to standard dyestuffs which *never* are anywhere near being pure colors. However, as artificial illumination has to do only with commercial pigments and dyes, the table serves as a useful guide in judging the effects produced on interior fittings by change in the color of the light.

Of common illuminants, none have any very decided color, yet most are somewhat tinged with color. One can tabulate them roughly as follows:

Illuminant.	Color.
Sun (high in sky).	White.
Sun (near setting).	Orange-red.
Skylight.	Bluish white.
Electric arc (short).	White.
Electric arc (long).	Bluish white to violet.
Incandescent (normal).	Yellow-white.
Incandescent (below voltage).	Orange to orange-red.
Acetylene flame.	Nearly white.
Welsbach light.	Greenish white.
Gaslight (Siemens burner).	Nearly white, faint yellow tinge.
Gaslight, ordinary.	Yellowish white to pale orange.
Kerosene lamp.	Yellowish white to pale orange.
Candle.	Orange yellow.

Outside the earth's atmosphere the sun would look distinctly blue, while its light, after thorough absorption in the earth's atmosphere, gets the blue pretty completely sifted out, so that the light of the eclipsed moon, once refracted by the earth's atmosphere and then reflected through it again, is in color a deep coppery red.

Arc lights vary much in color, varying from clear white in short arcs with comparatively heavy current to bluish white or whitish violet in long arcs carrying rather small current. The modern enclosed arcs tend in the latter direction and give the truest color effects with yellowish white inner globes, or shades. Incandescents, as generally worked, verge upon the orange. Of the luminous flames in use, only acetylene comes anywhere near being white, although the powerful regenerative burners are a close second. Incandescent gas lamps, at first showing nearly white with a very slight greenish cast, rapidly get a greenish or yellowish green after burning steadily.

It is evident then that a study of the color effects produced by colored illuminants is by no means irrelevant, for distinct tinges of color are the rule rather than the exception.

But this is not at all the whole story, for the general color of the illumination in a given space depends not only on the hue of the illuminant, but upon the color of the surroundings. Colored shades, of course, are in common use; sometimes with a definite purpose, more often with a mistaken notion of prettiness. Used intelligently, as we shall presently see, they may prove very valuable adjuncts in interior illumination. But far more important than this is the modification in the color of the light that comes from selective reflection at surfaces upon which the light falls. In every enclosed space light is reflected in one way or another from all the bounding surfaces, and at each reflection not only is the amount of light profoundly modified, but its color may undergo most striking changes. It is this phenomenon that gives its greatest interest to the study of color in illumination. Its importance is not always readily recognized, for few persons pay really close attention to the matter of colors, but now and then it obtrudes itself in a way that forces attention. Take for example a display window lined with red cloth and brightly illuminated. Passing along the street one's attention is immediately drawn to a red glow upon the street, while the lights themselves may be ordinary gas jets. To get at the significance of the matter, we must take up the effect of reflection and diffusion in modifying the amount and quality of light.

The Telegraph in Argentina.

Difficulty is experienced in operating the telegraph lines in the Argentine Republic on account of the quantities of fine web that float through the air, and which, settling on the lines, cause short circuits the moment the dew falls or when the weather is at all damp. Everything has been done to remedy the evil, but without avail, and it is now proposed to run an underground cable between Buenos Aires and Rosario. The difficulty is a very serious one, as it almost puts a stop at times to the work of the telegraph department in Buenos Aires—the number of messages being reduced from 300 to 400 an hour to only 30 to 40.

The Use of Aluminium Line Wire and Some Constants for Transmission Lines*.

By F. A. C. Perrine and F. G. Baum.

UNTIL the present time, discussions of the use of aluminium wire in line construction have been devoted to a consideration of the relative prices of copper and aluminium wires, the conductivity, tensile strength and other proportions of the aluminium wire being only considered as determining its relative price. During the past year the manufacturers of aluminium have demonstrated their ability to sell this wire at a price well below twice the price of copper per pound, and in consequence the new material has forced itself upon our notice and has demanded that we consider carefully all of its properties independent of any consideration of price. Having recently been forced into the purchase of a considerable amount of this wire by reason of the high price of copper and the low price of aluminium, the writers have made a careful study of the wire supplied, and now present the results obtained in hope that they may be of service to other engineers.

The line for which this wire was purchased is about 43 miles in length, and the country through which it runs varies in elevation from about one hundred feet above the sea level to at least two thousand feet; one-half lying in almost a straight line through a country almost level, while the remainder is over the mountains, through which the line runs almost straight, surmounting high hills and descending into deep gulches. In some cases the length of the poles were proportioned to decrease the vertical line deflection, but as an accurate preliminary survey was not available, much less grading of poles was possible than would have been desirable. This defect in pole setting was largely counteracted in the wire stringing by drawing of a number of spans at one time, so that at depressions and elevations there was a very little up or down strain put on the wire when it was tied to the insulators. The standard pole used was of square sawn redwood 30 ft. in length, 7 ins. square at the top, and tapering to 12 inches square at the butt, or about 11 inches at the ground line 5 feet above the butt. Each pole was gained for three cross-arms 20½ ins. on centres, the gains being cut three-quarter inch deep, into which the cross arms were bolted by single five-eighths in. through bolts. The arms themselves were 4 ins. x 4 ins. Oregon pine board for two pins each, the top and bottom arms being 3 ft. in length and the centre arm 4 ft. The wires on this system of construction are arranged in a hexagon, each side being 24 ins. in length.

This system of construction presents some advantages for three-phase working at high voltages for long lines, especially where the two sets of circuit are to be operated from the same bus-bars. If both of the wires on each arm are at the same potential, the arrangement of each circuit is that of an equilateral triangle, each side being 41 ins., while the minimum distance for leakage between any two wires of different phases is 36 ins. of cross arm and 20 ins. of pole, while the length of the longest arm necessary is much less than that in any other system of construction; the pole head is symmetrically loaded, and for these reasons the pole construction is exceptionally stable under all stresses.

The insulators used were a flat topped glass, triple petticoat type, about 5 ins. in height and 7 ins. in diameter, with a wire groove of about .35 ins. radius. The insulators are supported by eucalyptus pins of a length to give a distance of 4 ins. between the bottom of the insulator petticoat and the cross arm, eucalyptus wood having been used on account both of its availability in California for a special pin, and on account of its great strength, which is of extreme importance in the construction of pins of such length. Tests of a considerable number of pins made of eucalyptus, oak and locust show that the eucalyptus has about 20 per cent more strength than locust and 30 per cent more than oak.

For further insulation and preservation, the cross arms used were creosoted by a treatment in which the timber was at first dried carefully and then injected with ten pounds of dead oil of coal tar to the cubic foot, an operation requiring approximately thirteen hours for its completion, while the pins were boiled at a temperature of about 225 degs. F. for about eight hours in a compound of coal tar and asphaltum, a treatment which gave a better external surface than the creosote. This latter coating did not penetrate the wood materi-

*A paper read at the seventeenth general meeting of the American Institute of Electrical Engineers, Philadelphia, May 16, 1900.

ally, but after experimenting extensively with this wood at temperatures up to 225 degs. F. and pressures up to 160 lbs. per square inch without effecting any appreciable penetration of this wood, either with creosote or other extremely fluid materials, all idea of the use of a penetrating compound was abandoned, and an endeavor made to obtain a coating which would provide the most complete external protection.

On this line as erected the arms were braced by a bent angle iron brace, but this precaution seems now to be entirely unnecessary, and a subsequent line belonging to the Yuba Power Company, erected on much the same plan, is not braced at all. For arms of over five feet in length a brace is certainly advantageous, though it is the opinion of the writers that for high potential service the braces should be of wood mortised into the cross arms and nailed to the pole face.

The above complete physical details of the construction are unnecessary for the discussion of aluminium line wire, though it is believed that its stability when erected depends upon a careful study of all such conditions.

The line as erected carried only four wires arranged on the top and bottom cross arms, thus taking their location at the corners of a rectangle 24″ on the short side and 41″ on the long side. This arrangement was adopted for the purpose of making temporary use of some two-phase machinery which was in place and underloaded, allowing certain new customers to be taken on quite a year in advance of the contemplated completion of a three-phase plant for which the pole line was really designed.

It was at first feared that this arrangement of the wires would result in inductive disturbances between the phases, as the wires took their positions in the diagonally opposite corners of a rectangle, in place of the corners of a square, as is necessary for complete absence of mutual induction, but the anticipated trouble was not found. Careful measurements were made with one-phase short circuited and the other carrying about 20 amperes with a periodicity of 60 cycles per second, both with a Weston 75 volt voltmeter and a Rowland electro-dynamometer, with the result that no deflection was observable on the voltmeter, while the current read on the electro-dynamometer amounted to only about .001 amperes, the resistance of the dynamometer being 25 ohms and of the line 90 ohms. Only one additional question of installation needs attention, which is the presence on the tops of the poles of a barbed wire stapled to the wood of the pole and grounded at every fourth pole by a galvanized iron wire leading down along the pole and soldered to an iron plate 18 ins. square and one-eighth inch thick, set in the pole hole immediately under the foot of the pole itself. This wire was intended as a lightning guard, and it has apparently done very effective service in discharging the line in all weather.

The wire used was intended to be equal to No. 3 B & S copper wire in its electrical resistance, and the manufacturers were required to furnish this conductivity in a wire not weighing more than 420 lbs. per mile. All the wire supplied was carefully inspected by Mr. A. E. Kennelly, and his reports give the following averages for the total quantity:

Diameter	293.9 mils
Wt. per mile	419.4 lbs.
Resistance per mil foot	17.6 ohms at 25° C.
Resistance per mile at 25° C.	1.00773 ohms
Conductivity compared with copper	59.9% by dimension
Tensile strength of wire	1,549 lbs.
No. of twists in 6 ins. for fracture	17.9 lbs.
Tensile strength per square inch	32,898 lbs.

Comparing this with copper it is seen that this wire is approximately the same as copper in the following sizes:

Size of aluminium wire		No. 1	B & S	
Resistance of	" "	No. 3	"	copper
Tensile strength	" "	No. 5	"	"
Weight of	" "	No. 6	"	"

Therefore on the basis of the same conductivity the aluminium compares with copper as follows:

Diameter for the same conductivity			1.27	times	copper
Area	" "	"	1.64	"	"
Tensile strength	" "	"	.629	"	"
Weight	" "	"	.501	"	"

The mechanical properties of this wire present some well marked characteristics. In the first place, the number of twists necessary for fracture varies considerably, although the ductility test of wrapping six times around its own diameter, unwrapping and wrapping again is well sustained. This irregularity in the twisting test is generally a mark of impurity in wire, but we know so little as yet of the exact characteristics of aluminium in particular, and the twisting test is in general so unreliable that it is unsafe to base any exact statement on this one test, particularly as the same after erection proved reliable. In carefully performing the test for tensile strength no exact point could be assigned for the elastic limit, as the metal seemed to take a permanent set almost from the first, but at a stress of from 14,500 lbs. to 17,000 lbs. per square inch, there is a marked increase in the permanent set which indicates that the safe working load lies somewhere in this region. In this the characteristics of the aluminium do not differ materially from those of copper or other similar metals, and while this is a disadvantage it is not a singularity.

The fact that the wire will permanently elongate if seriously strained makes it necessary to use the utmost care in the erection of lines, and also the known high coefficient of expansion with temperature changes taken in conjunction with this property renders care in line stringing especially important and difficult.

For the purpose of ascertaining exactly what were the changes with temperature that might be anticipated, the Pittsburg Reduction Company undertook a series of experiments by means of the observation of 200-ft. spans of wire at temperatures varying between 6 degs. F. and 55 degs. F., and at the same time the authors carried on a similar series of experiments on a 150-ft. span at the Leland Stanford, Jr., University, in which the temperatures varied between 20 degs. F. and 80 degs. F. From the results of these experiments a coefficient of expansion with temperature was obtained, which was used in calculating sets of tables for the instruction of the line foreman which gave the tensions and deflections at the different temperatures encountered. These tables were calculated by use of the ordinary approximate formula for the tensions and deflections of a suspended wire and the method used for obtaining the coefficient of temperature expansion removes the usual objection to the formulæ that they do not take into account the elasticity of the wire itself, which produces serious errors if an attempt be made to use the true coefficient of linear expansion by changes of temperature. In fact, the coefficient of linear expansion obtained from these experiments is less than one-half the value of the true coefficient of linear temperature expansion, but its use is justified by the fact that the tables as calculated have been frequently verified experimentally, both at the testing stations and in the field, while the line was being strung.

A copy of the table above referred to, together with the following instructions was issued to the line foreman, who was also provided with a thermometer, a dynamometer and a pair of targets for measuring the deflections.

Instructions to line foreman in stringing wires:

1. All spans are to be strung with deflections and tensions as specified in table.

2. Up and down hill spans to be strung to correspond with level spans. In case level spans cannot be used, then employ dynamometer, and ease all wires over cross-arms.

3. All ties are to be made at one time by signal.

4. All ties are to be made by crossing wires around insulator serving three times around wire, and twisting behind insulators; the ends of the tie-wires are not to be cut but bent back toward insulators.

5. Tie all wires in the outside of the insulators, except at corners where all are to be tied so that the strain is against the insulator.

6. Joints are to be made by means of sleeves twisted two and a half times, the ends of the wires being given one turn by hand around the wire. No tools being used, except in twisting the sleeves and cutting off the ends of the wires. Before inserting the wire in the sleeve, the ends of the wire must be roughened by draw filing.

7. Barb wire is to be laid along the roof of the pole and held by three staples driven in tight, but without kinking the wire. Ground wires are to be soldered to the barb wire and at the bottom of the pole to the wire leading from the ground plate. All soldering acids must be carefully washed away after the soldering is done.

8. Beginning between poles one and two, all wires are to be barreled by shifting one pin, and same to be repeated between poles 21 and 22 and 41 and 42, and so on. Barreling always in the same direction of twist every twenty poles. A record must be kept of the location of every wire and every pole.

The greatest care must at all times be taken against kinking or scarring the wire: wherever the wire is accidentally kinked or scarred it must be cut and spliced.

The targets mentioned above consisted of light sheet iron strips about 2 ft. long and 2 ins. wide, with an aluminum loop bent into

an eye at the top, by means of which they could be hung from the line wire. These targets were painted in three or four colors, with bands one inch wide. In use, the captain of the linemen would hang his target on the wire to which a man on the next pole had also hung a target; then, as the wire was being pulled into place, he would sight from a band on his target to the same band on the adjacent target, and when the wire came into line with these two bands the signal would be given for all the linemen to tie at once. As a result of this method of stringing, an exceedingly uniform line and one strong in accordance with the temperature was obtained.

One of the most serious problems in connection with the use of aluminium is in the choice of a proper joint. This metal is so highly electro-positive that it is unsafe to expose it to the elements in contact with any other material, as electrolytic corrosion is almost sure to follow such construction. Many of the failures which have been reported of this metal have been due to a neglect of this fact; as notably in the case of the plates on the yacht *Defender*, where the plates have been corroded at the contact with the bronze rivets used in fastening them to the frame. Whenever this metal is soldered or used in contact with any other metal, the joint should be thoroughly waterproofed to prevent such action. After discussing many joints, it was finally determined to abandon any attempt to solder or clamp the wire in any manner, and the joints were made by slipping the ends of the wire into an oval aluminium tube about 9 ins. long, which was then twisted with a pair of clamps similar to those employed in twisting the McIntire connector. After twisting the tube a turn was taken by hand of the loose ends and the wire cut off close. The joint produced proved practically equal to the original wire in both tensile strength and electrical conductivity.

This wire was erected during the winter of 1898-99, which was an unusually open winter over the whole State of California, allowing practically continuous construction work, though the temperature varies all the way from about 30 degs. F. to 80 degs. F. at times when the wire was being strung. After it was finally erected it remained about three months on the poles before the machinery was delivered and put in place. During the first month of that time three breaks occurred which were all apparently due to flaws in the material, but after these breaks were repaired the line wire gave absolutely no trouble whatever, though various accidents occurred to other parts of the construction. Many insulators were shot at and broken, bale wire and bale rope was thrown over the line, a twig short-circuited one phase and fell down burned, a large bird was killed by contact with the wires, and finally several porcelain insulators with porcelain pins were broken off and hung suspended by the wire. In January and February of the present year this whole line was taken down to give place to a much heavier one of the same material, an opportunity for such a total change having been found after the complete destruction of the power house by fire last November.

During the past two years other lines of aluminium wire have been erected on the Pacific Coast, all but one of which have given a considerable amount of trouble from causes that are not entirely apparent.

One line in Nevada County, erected at about the same time as that we have been describing, and for which the wire was of practically the same lot, has given no trouble whatever.

The power transmission lines of aluminium wire about Seattle have broken a few times, but have not given serious trouble. The breaks in this line, so far as the writers have been informed, seem to have been due to not allowing enough sag at the higher temperatures, and a consequent overstraining of the wire in cold weather.

The most serious difficulties have been encountered by the telephone company in Washington and Oregon and by the Yuba Power Company. In all of these cases it seemed almost impossible to keep the wires on the poles in certain sections, and in these sections the lines have been finally taken down and replaced by other wire of either copper or aluminium. The writers have examined many breaks from these lines, and would judge, from the appearance of the fracture, that the cause, whatever it may be, was similar. In those breaks there are many small flaws, but by far the greatest majority are clear, sharp fractures, with but a slight reduction of area, and that entirely on one side, a break very characteristic of improperly mixed and brittle alloys. Partially from the appearance of the fracture and partially from the facts that the breaks occur only in certain sections of the line, the writers are of the opinion that this trouble is due to the presence of impurities in the material. This view is strengthened by the fact that when measurements were made on the line of the Yuba Power Company, the resistance of the whole line was found to be 10 per cent greater than it should have been if it were made of the quality of material described in the earlier part of this paper. Furthermore, in one-half of this line there were no breaks at all due to defects in the wire itself.

As a general conclusion, it is the opinion of the writers that aluminium can be safely used in place of copper where the proper precautions are taken in inspecting the wire before it is erected, and in erecting it with due consideration of its peculiar properties of low and indefinite elastic limit, high coefficient of temperature expansion and active electrolytic power.

Indicating our faith in this opinion, it may be noted that for the new line soon to be erected an aluminium strand three-quarter inches in diameter has been ordered. This strand will be spliced with aluminium sleeves, and in the whole construction about one million pounds of aluminium will be employed.

Conditions of Electrolytic Corrosion in Brooklyn.*

BY SAMUEL SHELDON.

THE borough of Brooklyn spreads over 60 square miles, and is covered with a network of surface trolley tracks. During the rush hours about 1100 cars run upon these tracks and are supplied with current from seven power stations, supplying in all 47,000 amperes. Four of these are situated upon the East River water front and supply over 80 per cent of the full load current. The currents return to the power houses by the following paths:

First by the rails of this system, which are all bonded together, different lines employing different bonds. There are, for example, the cast weld bond, showing a conductivity of 100 per cent or more of continuous rail, the Johnson electric weld bond, showing 85 per cent, the R. P. Brown interfoliated bond giving 94 per cent, and the protected rail bond giving varying conductivities according to size of bond and rail.

The second path of return results from the peculiar geographical position of the borough, and the peculiar conditions of the traffic. All of the car lines lead to the borough of Manhattan. During the rush hour at 6 p. m., nearly half of the cars in operation at the time are receiving current within a radius of one mile of the Brooklyn end of the Brooklyn Bridge. At this time a large proportion of the currents are returned by way of the East River.

The third path at present takes but a small part of the current, and consists in return feeders connected with the tracks at various points.

The fourth path, which it is the intention of the engineers of the Brooklyn Rapid Transit Company to utilize extensively along certain lines, has become available as a result of the combination of the elevated railroad interests and the trolley railroad interests. It is, namely, the whole elevated structure. This is also used at present as a return circuit for the currents used in the operation of the few third-rail trains which are now upon the elevated lines.

The fifth return path consists of the mains and the service pipes of the municipal water department, the mains and service pipes of the Brooklyn Union Gas Company, the cables of the New York and New Jersey Telephone Company, and the underground tubes of the Edison Electric Illuminating Company. These returning currents set up differences of potential between all underground conducting objects. The difference in potential between any two given points varies throughout the day, because of variations of the traffic conditions. In a similar manner it varies with the seasons, and is quite different on Sundays from what it is on week days. Furthermore, the potential differences are gradually growing smaller in the average, because of the better conductivity of the Transit company's return circuit. They are also changing because of changes in the distribution of load among the power houses.

The difference of potential between the rails and the hydrants, and the rails and the gas mains varies from a fraction of a volt to 25 volts. Between the two ends of the Brooklyn Bridge there has been a difference of potential of 20 volts. Each power house is surrounded by equipotential curves, and in the immediate vicinity of each the fall of potential is quite rapid.

The city may be divided up into districts, each power house drawing current from a district. The boundaries of these districts hold

*A paper read at the seventeenth general meeting of the American Institute of Electrical Engineers, Philadelphia, May 16, 1900.

tl.e same position towards the returning currents of electricity as mountains do towards the water of a watershed. The difference of potential between a point on the boundary of a district and the ground in the immediate vicinity of the power house supplying that district has been found to reach as high a value as 40 volts.

The municipal water mains pass through nearly all streets of the city and vary in size from 48 inches in diameter down. They are all made of cast iron. Some are known as Scotch cast iron pipes. These were made in Scotland and are of a peculiarly hard and tough cast iron, which exhibits a very white surface on fracture, indicating a combination of the contained carbon. These pipes can always be recognized by ribs which occur at every two feet along the surface, and which are about four inches wide. These ribs consist of a thickening of the metal intended to furnish a firmer seating and more perfect joint for taps and branches.

Other mains are of American manufacture, are very much softer than the Scotch iron, but also exhibit a white surface on fracture. The employees of the water department prefer to work upon these mains because of the much less labor required to operate the cutting tools, owing to the relatively greater softness. In no case has an electrolytic corrosion of the water mains been discovered in the city, although many cases of corrosion of the service pipes have occurred.

The Brooklyn Union Gas Company has 755¾ miles of gas mains. These are all made of white cast iron. From them are led wrought iron service mains, which are supplied with malleable iron and in some cases brass fittings. There are 272 miles of wrought iron service pipes. These with their fittings have suffered corrosion in very many cases. Thirty-eight service pipes on one block were completely destroyed in three years. However, not until within a year has any corrosion of the mains been discovered, and then in but two cases. In each case the main was in an excessively dangerous district.

The gas company claims that there has been an abnormal increase of leakage since the introduction of electric traction in 1894. The leakages for various years are not accessible, but during 1899 it amounted to 13 per cent of the total production of 4,500,000,000 cu. ft.

The New York and New Jersey Telephone Company has many miles of underground cables, the lead coverings of which have been pitted and perforated in many cases by electrolysis. The company, however, is fully aware of the possibilities of electrolytic corrosion, keeps itself informed of its cables, and concerning the stray currents in their sheathings.

The Edison Illuminating Company has over 100 miles of underground tubing. These tubes have suffered considerably from electrolytic corrosion, doubtless resulting in many cases in the short-circuiting of the enclosed conductors.

Considering the magnitude of the system of the Rapid Transit Company, considering the time that it has been in operation (the first electric car was operated in 1894), considering the poorness of the ground return which existed on parts of the system up to within three or four years, it is surprising that no evidences of the corrosion of cast iron have been discovered with the exception of the two cases mentioned above.

The apparent immunity of cast iron was noticed by the Board of Commissioners of Electric Subways of the City of Brooklyn, and attention was called to the fact in several of their reports. These reports indicate that in their opinion the immunity was due to the peculiar chemical constitutions of the special kinds of cast iron of which the mains were constructed. It hardly seems credible that such a form of iron could exist.

To experimentally test the matter, samples of Scotch and American pipes have been obtained from the Water Department as well as samples of the gas mains from the gas company. These have been used as anodes in various electrolytic cells. The electrolytes consisted of samples of earth from various parts of the city, moistened in some cases with distilled water, and in other cases by hydrant water or salt water. These cells were subjected to voltages of various magnitudes. In every case the anode was corroded, showing conclusively that there is no immunity because of chemical constitution.

In preparing some experiments to determine whether or not the apparent immunity of cast iron mains was due to an electrolytic polarization e. m. f., due to absorbed gases in the pores of the rough exterior of the pipes and of sufficient magnitude to prevent the sending of any considerable current by the stray voltages, the true cause of immunity was discovered. In the casting of pipes in sand molds, the hot iron unites with a layer of the sand to form a silicious compound probably silicate of iron which forms a thin coating over the surface of the completed pipe. This coating is extremely thin, and is a non-conductor of electricity. It is not continuous, but contains perforations in many places. If a piece of pipe be covered with insulating paint, exposing only the rough sand-pocked exterior surface, and if it be made an anode in an electrolytic solution, much less current will flow through the solution under a given impressed e. m. f. than under similar conditions with an anode exposing a filed surface of equal area. In some cases, no current at all will pass until the impressed voltage rises to a certain minimum value. If, however, a current be made to pass for a few moments under a moderately high impressed e. m. f., the rough sand-pocked surface becomes conducting throughout. The protecting film or skin seems to act like the non-conducting film thrown down in an aluminum cell. The existence of a perforated skin can also be shown by endeavoring to close a circuit, which contains a current-indicting device, by means of a wire on the sand-pocked surface. The end of the wire may be rubbed around in many places before there is any indication of a closed circuit. Then, again, a spot will be found where the circuit is closed, and there is no indication of resistance of any magnitude at the point of contact.

There is another thing which is perhaps equally as influential in preventing electrolytic corrosion, and that is the resistance offered by the soil. The various interested companies have observers in the field recording the potential differences between the rails and their underground system. Whenever the system is positive to the rail, the district is considered as dangerous, and corrosion is expected. It is well to notice that as corrosion will result at one side of any discontinuity of a metallic circuit, it may be expected to occur even in districts which are not considered dangerous. On the other hand, the amount of corrosion which will take place in a dangerous district under a given potential difference is dependent upon the smallness of the resistance offered by the soil. Now the measurement of the resistance of soil under laboratory conditions gives information which can hardly be applied with propriety to street conditions. It is much to be preferred that the resistance between the tracks and the other systems should be measured directly. While it is impossible to determine the resistance in such a manner as would enable one to calculate the current density at any point, and to ascertain the direction of flow lines, yet some idea of the magnitude of the ground resistance can be determined in the following method, which makes use of a low reading voltmeter (0 to 3 volts), and a battery having an e. m. f. of e volts. Let the resistance of the voltmeter be R ohms; then at any reading of the voltmeter θ, the current which is traversing that voltmeter is $R\theta$ amperes. Now to measure the resistance between two points, for example, a point on a rail and a point on a hydrant, take the following three readings:—E', with the voltmeter alone connected between the two points; E with the battery alone connected to the voltmeter, and θ with the battery and voltmeter connected in series between the two points. The effective resistance X between the two points is determined by considering that

$$\frac{E + E'}{R + X} = \frac{\theta}{R}$$

whence

$$X = \frac{(E \pm E')R}{\theta} - R$$

$$= R\left(\frac{E \pm E'}{\theta} - 1\right).$$

For ground voltages, which are less than one volt, two cells of ordinary dry battery are sufficient. The assumption is made that the small current sent by the battery in making the measurement does not produce an e. m. f. of polarization of appreciable magnitude. This is unquestionably warranted when we consider the exposed area of the pipe or rail, and the smallness of the current. Measurements of effective resistance taken at a great many points between the hydrants of the water system and the rails in Brooklyn give values lying in the majority of cases between 10 and 35 ohms. The character of pavements seems to have no great influence on the resistance of the soil underneath. Measurements have been made in the case of asphalt, cobble stone, Belgian block, granite block, vitrified brick, and dirt roads. In all cases there were variations in resistance with different conditions under the same pavements, but the average resistance was nearly the same in all cases.

It is very probable that the current which would flow through the resistance indicated by these measurements under a given difference

of potential would be distributed over a large area of pipe surface, and therefore the current density under voltages of the magnitude of those which exist in Brooklyn, would require a long time to result in destructive corrosion.

These investigations have been carried out in collaboration with Mr. Charles V. Rapelje.

CURRENT NEWS AND NOTES.

REDUCED FARE FOR MERCHANTS.—The several trunk line associations will grant reduced rates to merchants within trunk line territory for the dates Aug. 25-29 inclusive and Sept. 1-4 inclusive, the tickets to be good to return 15 days from date of sale.

THE CANADIAN ELECTRICAL ASSOCIATION.—Owing to the great fire, the conmention of the Canadian Electrical Association which was to have been held at Ottawa this month, has been postponed to next September. In the meantime another meeting place will be chosen. The convention of 1901 will probably be held at the Capital.

MEETING OF RAILWAY TELEGRAPH SUPERINTENDENTS.— The nineteenth annual meeting of the Association of Railway Telegraph Superintendents will be held at the Wayne Hotel, Detroit, Mich., on June 20, 21 and 22. Several interesting papers will be read, and topics of vital concern to railway telegraph men will be discussed. Suitable space will be provided for exhibits.

MARCONI IN AMERICA.—Mr. G. Marconi arrived at New York June 2 on the St. Paul. He will only remain in this country a short time, the object of the visit being to attend to some business matters. Mr. Marconi took part in a concert on the St. Paul, entertaining the saloon passengers with a piano solo. It is said that recently Marconi has successfully transmitted wireless messages over several hundred miles.

A LARGE BUSINESS TRANSACTION EFFECTED BY TELEPHONE.—A business firm in New York City last Saturday closed a deal through its agent in St. Paul, Minn., by telephone, the transaction involving about $600,000. The business was transacted between the firm and its agent by the aid of an exchange operator at New York, who, by his experience, was better able to carry on the conversation over the long distance. Nearly an hour was occupied in the transaction, and a heavy telephone bill was incurred.

THE CARBORUNDUM COMPANY, of Niagara Falls, in which many Pittsburgers are interested, have formed the Graphite Company. They will build a plant in connection with the parent works for the purpose of manufacturing graphite very extensively after the patents of E. G. Acheson, the president of the parent company. This decision regarding the formation of the new company was made at the recent annual meeting of the Carborundum Company held in Pittsburg. The old board of directors and officers were all re-elected.

SALE OF SECKNER COMPANY IN ST. LOUIS.—A note in our issue of last week concerning the sale of the Seckner Company, St. Louis, contained several inaccuracies. The company was not sold to the Imperial Electric Light, Heat & Power Company, though the purchasers are also interested in the latter company. For this reason, also, the statement is incorrect that the Imperial Company assumed the liabilities of the Seckner Company, including contracts for necessary machinery and equipment. New contracts have been entered into for direct-current apparatus and arc apparatus. The Seckner Company will continue in business. The statement in the note that "representatives of J. G. White & Co., of New York, lately examined the plants and equipments of the Laclede, Missouri-Edison Electric and Imperial companies, as well as their franchises and financial standing," is, we learn, incorrect; the examination being confined to simply looking over the mechanical end of the Imperial plant regarding machinery, etc.

PROTECTING COMPOUND-WOUND DYNAMOS.—To protect compound-wound dynamos against an overload or short circuit, circuit breakers have usually been employed which break the main or working circuit of the dynamo. In a patent issued May 29 to Chas. M. Black, it is stated that this means is not free of objection, as circuit breakers require constant attention and repair, and are not infrequently destroyed. Moreover, they are generally expensive in initial cost and expensive to maintain, and if they fail to operate, the machine which they are designed to protect may sustain serious damage. An automatic apparatus is described to obviate these objections, which short-circuits the series windings of a compound-wound dynamo and opens the equalizer connection when two or more such machines are in parallel, or cuts out the series winding without breaking the main or working circuit. The short-circuiting device consists of an electromagnet, which, in the case of a short circuit or overload, releases a switch which short-circuits the series winding, thereby converting the dynamo into a simple shunt-wound machine without breaking the main circuit. In the case of two machines in parallel, the same movement also breaks the equalizer connection. The device may also be applied to open the circuit of the series winding without breaking the main circuit.

MULTIPLE-UNIT RAILWAY CONTROL.—In one multiple-unit system of electric railway traction, each controller is provided with a small pilot motor or other electrically-controlled device, which is in turn controlled by a master controller from a selected point on the train, the controlling current being derived from the main source of supply. An objection to which this arrangement is open is that if the source of supply fails from any cause, the controllers are left in the last running position; and when the circuit is again established the motors, now at standstill or running slowly, are subjected to a potential depending upon the position which the controller last occupied, which may be injurious to the motors as well as disagreeable to the passengers. In a patent issued May 29, Mr. Frank E. Case describes a means for obviating this latter defect. Briefly, the invention consists in supplying current from a separate source of energy to return the motor controllers to their off position should the main source of supply fail. The auxiliary source of supply consists of a storage battery which is connected to the circuit in such a manner that it is continuously charged from the main source during normal conditions, but as soon as the source of supply wholly or partially fails, the storage battery is operatively connected in circuit in such a manner as to actuate the pilot motors. The functions of the auxiliary storage battery circuit are controlled by circuit breakers.

THREE-PHASE ELECTRIC RAILWAY SYSTEM.—In a three-phase electric railway system, the preferred construction consists of two iron third rails in two legs of the circuit and the two track rails in multiple in the other leg. In this case, each car will receive current on the average through a heavy iron conductor in each leg of the circuit of a length equal to about one-fourth of the distance between transformers, while in some positions the path through iron will be equal to half the distance between the transformers for each leg of the circuit. Such supply conductors of iron thus constitute an inductive conducting system which seriously interferes with the proper working of the induction motors employed in this system, the passage of the low-tension alternating currents—necessarily of some considerable volume—producing an inductive drop such as to sometimes practically wipe out the impressed voltage as the car starts, and in all cases to seriously interfere with the operation of the motors. This difficulty may be overcome by the use of a large number of transformers connected at frequent intervals, but such an arrangement is very expensive and introduces large losses. Even if third rails of copper or a trolley wire sufficiently heavy to carry the large currents needed should be employed, there would still be an inductive drop in the track rails, which would, with this arrangement, seriously unbalance the system. Each transformer might be replaced by an inverted rotary or other source of alternating current, but the difficulty above mentioned would still persist, usually in an even greater degree. In a patent issued May 29 to Albert H. Armstrong, a method to avoid the above difficulties is described, which consists in employing only a reasonable number of sources of current and connecting each of them to the track rails and to the third rails at a number of different points by heavy leads of copper, thus constituting a substantially non-inductive system—the conductors being preferably arranged in a triple non-inductive cable. The conductors of the main supply circuit are carried the whole length of the railway and connected at intervals to transformers. The secondaries of these

transformers, arranged in a triple cable, are in turn connected to conductors which parallel the track, and the third rails and track rails are connected to the secondary line at relatively short intervals.

THE STRIKE SITUATION.—Strikes among electrical workmen in various parts of the country, in the main, continue. In St. Louis, much violence attends the strike of the street railway men. It has been in existence four weeks, and the end is not yet in sight. Last week the sheriff summoned a posse of citizens to aid him in suppressing disorder, but this action evidently had no moral effect whatever upon the lawlessly inclined. Several persons have been killed and many wounded as a result of the rioting, and much damage has been done to the railway company's property by dynamite, fire and other means of destruction. In Philadelphia, the electrical workers have proposed the appointment of a court of arbitrators to effect a settlement of the "differences" between themselves and their employers. In Cleveland, the strike of the linemen of the Cleveland Telephone Company has been declared off, the men having returned to work at the old rate of wages. The strike in Baltimore among the electric light men continues and, according to the latest reports, is likely to spread. Egyptian darkness, or something akin to it, prevails in the city at night. The electric railway employees are also on a strike for higher wages. It is reported that the electric light men are not striking directly for higher wages, but for what is equivalent to a reduction of line voltage. One of the leaders points out that the voltage of the wires has been increased from 1000 to 2750 within the past year, which makes the wires "much hotter and more complicated than formerly," making the men's work much more dangerous. In view of the extra hazard, a corresponding raise in wages was hoped for, but the company's officials did not look upon the situation in the same light, and the strike was the result. It is reported that the telephone linemen may join their striking brethren. The Electrical Contractors' Association in Pittsburg replied to the demands for an increase of wages made recently by Local Union No. 5 of the International Brotherhood of Electrical Workers. The workers asked for an increase per day of 12½ per cent, or 35 cents straight; the contractors' reply contains a compromise of 7½ per cent, or 30 cents. The offer was declined. What will be the outcome cannot be stated as yet, because the old scale does not expire until the first of July. The linemen of the Bell Telephone Company in Rochester, N. Y., went on strike on May 29 for an eight-hour schedule and more pay for overtime and Sunday work. The New England Telephone Company has inaugurated a nine-hour schedule for its linemen and inspectors throughout its territory. A short time ago the linemen received an advance in wages of $2.50 per month.

LETTER TO THE EDITORS.

Transformer Magnetic Leakage.

To the Editors of Electrical World and Engineer:

Sirs:—Commenting on my communication in your issue of May 19, the letter of Mr. John Whitehead, Jr., in the succeeding, expresses views, aside from certain statements to which I must take exception, that are in the main correct, but somewhat artificial or academic. While this may be desirable or convenient for a mathematical treatment, it is apt to lead to confusion and discussion about actions which are themselves simple, and in accord with the working of other electrical apparatus. I beg your indulgence, therefore, for again treating the subject with the object of harmonizing the theories of transformer action.

Mr. Whitehead's remark that the leakage field is a source of self-induction is simple and correct. The statement that the drop of voltage, which occurs at the terminals of an exploring coil wound in with the primary, when the secondary is loaded, results from primary resistance, is one in which I not only concur, but which it was one of the objects of my experiments to demonstrate. At the time the original paper was written, magnetic leakage, in the sense of primary flux failing to link with the secondary, was the reason usually assigned for the apparent change of ratio or drop of the secondary circuit. For the decrease of core loss with load, no satisfactory explanation had been afforded. One of the objects of my paper was to point out that nearly as much primary flux escaped linking with the secondary at no load as at full load, i. e., that leakage as popularly understood was not the cause of the drop, but that it was a resistance drop—core flux decreasing with load owing to the lowering of the effective primary voltage by the resistance drop in the primary. Therefore, the decrease in flux through the secondary occurred not because the lines were blown out into the air by the rising secondary current, but because the flux through the primary had already decreased.

Mr. Whitehead's definition of magnetic leakage as "the lines of force which pass through one coil, but not through the other," accords with that of Bedell in a mathematical treatment of leakage, but is not the sense in which the word is generally employed when talking of trasformers, nor its significance when to it is attributed the unfortunate drop of transformer secondaries with load.

No less an authority than Fleming ("Alternate Current Transformer," fourth issue, p. 457), speaking of the inductions $\mathfrak{B}_1$ and $\mathfrak{B}_2$, linked with primary and secondary circuits, says: "$\mathfrak{B}_1$ has not the same value as $\mathfrak{B}_2$ when the secondary circuit is loaded, because some lines of force which are linked with the primary circuit escape passing through the secondary, and this constitutes the magnetic leakage of the core." And again on the following page: "This is because magnetic leakage intervenes to cause the induction through the secondary circuit to be less than the induction through the primary circuit; that is to say, all the lines of force which are linked with the primary are not linked with the secondary circuit. The difference between $\mathfrak{B}_1$ and $\mathfrak{B}_2$ being taken, gives us the curve of magnetic leakage." I append his diagram illustrating magnetic leakage, found on page 107 of the same work.

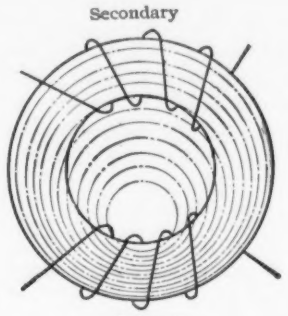
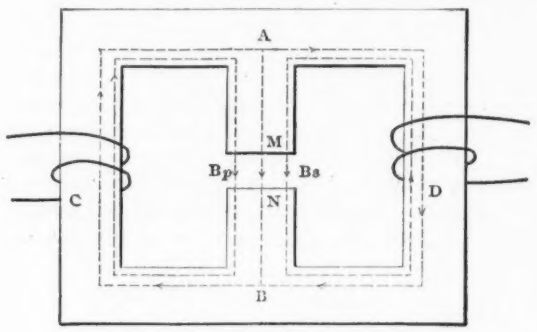


FIG. 1.

To Mr. Whitehead's statement that "It is thus seen to be possible that each coil may have the same number of lines passing through it and still all the lines of either coil need not be common to them both," I must take decided exception. Also to the remark following: "Thus, each coil may be considered as encircled by two fields, the main core flux common to both coils and the leakage flux of the particular coil considered."



A Divided Magnetic Circuit

FIG. 2.

In order to make my meaning clear, I refer to diagrams similar to Bedell's ("Principles of the Transformer," p. 175), using similar treatment.

We know that the primary coil at *C* sends most of its flux through the secondary coil at *D* and a part through the leakage path *MN*. For the purpose of a mathematical discussion, we are also at liberty to assume that the secondary at *D* sends most of its flux through the primary at *C* and a part through *MN*. Assign a numerical value to the lines of the primary flux, say 100, and to the secondary flux 90, and

assume that 10 lines of primary flux and 9 of secondary flux pass across the leakage path. Then the direction of the 10-line leakage circuit of the primary coil *coincides,* in the core, with the direction of the prevailing core flux. The direction of the 9-line leakage circuit of the secondary is *opposite* in direction, in the core, to the prevailing flux. It therefore neutralizes 9 lines of that flux, and we have 100

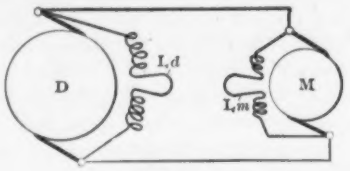


FIG. 3.

lines linked with the primary, 81 with the secondary and 19 in the leakage path. It is impossible where leakage is present, that the same number of lines really traverse each coil. It is only an assumption. We cannot actually have lines flowing in opposite directions in the same part of a core at the same time. Furthermore, I consider it an arbitrary assumption to state that the leakage lines $\mathfrak{B}_s$ are due to the secondary field. Take the analogous case in electrical conductors of a dynamo driving a motor between whose brushes an electrical leakage exists, as shown by *Lm* in the diagram.

Would any one say that the current in this path was generated by the counter e. m. f. of the motor? Why should we then assume that the magnetic leakage across the region of counter m. m. f. of a secondary coil is a product of its back m. m. f. It seems more natural and reasonable to think of $\mathfrak{B}_p$ and $\mathfrak{B}_s$ as flux generated by the primary which fails to cut the secondary.

Such being the case, exploring coils wound in with *C* and *D* will measure the actual resultant fluxes linked with them, and the difference between their voltages measures what is properly termed magnetic leakage. That the difference between their voltages from no load to full load is nearly constant shows that the amount of primary flux failing to penetrate the secondary is nearly constant at all loads. While the more important manufacturing companies to-day give the resistance drop of transformers as the larger loss and the leakage drop as very small, this is not due to improvements in transformer construction by which leakage has been greatly reduced. It is the modern and correct way of describing the drop. At the time my experiments were made and until very recently, leakage was always mentioned before resistance drop; and I venture to say that at present many electrical men, if asked for the reason for secondary drop, would give magnetic leakage, in the sense that Fleming uses the word, as an important factor at heavy load.

JOSEPH BIJUR.

NEW YORK.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Johnson-Lundell Generator.—ELIHU THOMSON.—A communication referring to the description, mentioned in the Digest May 12. He claims the priority for the device of extending the field pole in the direction of revolution, so as to throw the gap between two consecutive field poles forward. The dividing of the field poles by slots, so as to make one or more sections of the field pole, is also quite old, and is besides an expedient of very doubtful utility; he does not think it has any other effect than to increase the general reluctance of the field pole.—*Lond. Elec., Elec. Rev.,* May 18. A brief editorial note saying that the extended pole without the slot, and the slot without the extended pole, are equally ineffective in preventing distortion of the field; it is in the successful combination of these two features that the merit of the invention is said to consist.—*Lond., Elec. Rev.,* May 18.

Speed Control of Motors by the Variation of Impressed and Counter E. M. F.—A note referring to the article of Mather, noticed in the Digest May 19. "The question for consideration is whether the extra cost of wiring and of the commutators, together with the proportional cost of equalizing motors, would cost more than the usual reduction gear. The disadvantage of the electric system compared with the mechanical, is that the power of the motor would be reduced with its speed, as while the voltage of the brushes is reduced, the current capacity of the armature is not increased. It would seem, therefore, that the system, while interesting from an electrical point of view, is not likely to find favor commercially."—*Lond. Elec. Eng.,* May 18.

Alternator.—Two communications on the question of what would happen if one of the halves of the armature of a stationary field alternator, which has its halves connected in parallel, is injured and is completely disconnected, and if it would then be paralleled with other machines. It should be possible for the injured machine to be run in parallel, but a force would be set up tending to make the shaft bear with great pressure against the bearings.—*Lond. Elec. Eng.,* May 18.

REFERENCES.

Theory of Alternators.—BEHREND.—A long, illustrated French abstract by C. F. G., of his serial in the ELEC. WORLD AND ENG. Jan. 20, 27, Feb. 3, with a few critical notes.—*L'Eclairage Elec.,* Apr. 28.

Unipolar Dynamos.—DE PUYDT.—An explanation of the principle of this type.—*L'Eclairage Elec.,* Apr. 14.

Friction Loss in Dynamos.—DETTMAR.—An article, in which he gives a summary of his investigations noticed in the Digest June 24, July 8, Oct. 7.—*Dingler's polyt. Jour.,* vol. 315, No. 6; abstracted in *Phys. Zeit.,* May 12.

Friction of Induction Motors at no Load.—BRAUN.—An illustrated French translation of the German article noticed in the Digest Nov. 4. *L'Elec.,* May 12.

Synchronizing Alternators.—RITTER.—An illustrated French abstract of the German article noticed in the Digest Feb. 3.—*L'Eclairage Elec.,* Apr. 14.

Connecting Alternators in Parallel.—An illustrated description of a device of Schuckert & Company, by which, with the aid of incandescent lamps arranged in a circle, the moment is indicated when two three-phase alternators, to be connected in parallel, are in synchronism.—*Elek. Rund.,* May 1.

LIGHTS AND LIGHTING.

Arc Lamp Without Carbons.—A brief note on a recently patented arc lamp, which consists of an air-tight vacuum glass globe, containing "two L-formed aluminum arms with platinum points, regulated by a simple pendulum." The wear and tear are claimed to be very small, so that only in rare cases a replacing of the aluminum arms, once per year, becomes necessary.—*Elek. Rund.,* May 15.

Train Lighting.—KOHLFUERST.—An article on the Dick system and the improvements which trials on Austrian railways since 1897 have brought forward. He calculates the price of the first installation and operation for a train of 10 cars, each lighted by 100 candles, for a lighting time of 6 hours per day, and finds 0.26 cent per 10 candle-hours, while lighting with oil costs 0.56 cent and electric lighting with accumulator, 1.76 cents.—*Schweiz. Bauzeit.,* March 31: briefly abstracted in *Le Mois Scient.,* April.

REFERENCES.

Train Lighting.—GRUENWALD.—A long, well-illustrated article, giving an outline of the historical development of electric train lighting and a detailed description of the Stone system.—*Elek. Anz.,* May 10, 13.

Arc Lamps.—RICHARD.—A well-illustrated description of quite a number of new types of arc lamps.—*L'Eclairage Elec.,* May 5.

POWER.

Electric Power Transmission.—A long, anonymous article, abstracting and criticizing some points in Forbes' paper (Digest June 2). The advantages of a frequency of 25 cycles, as used at Niagara

on Forbes' recommendation, are questioned. It is said that the disadvantages of a low frequency, such as 25 cycles, far outweighs its advantages for all power transmissions over distances less than 100 miles, unless synchronous converters of large size are used. For long transmissions, say 100 miles, a low frequency must be used on account of the inductive drop in the overhead lines. The more obvious disadvantages of a low frequency are said to be that all lighting work by means of static transformers becomes impossible; that generators, transformers and motors become excessively heavy and therefore unduly expensive, which extra expense is of the nature of 30 per cent for motors up to 30 horse-power and about 15 to 20 per cent for the generators; and that the performance of the generators, particularly with regard to the pressure regulation, is greatly impaired. Regarding the questions of parallel running of the generators, a 50-cycle plant is said to be just as good as one of 25 cycles. Motor generators are preferred to synchronous converters; for short transmissions, especially with underground cables, the non-synchronous type is thought to be the best on account of the simple design, character and simplicity of the starting arrangements of the induction motor; if, however, large amounts of polyphase power have to be converted into direct current at the end of a long transmission line and then distributed, synchronous motor-generators should give the best results. A part of the second part of Forbes' paper on the use of boosters in transmission lines, with various tables, is highly endorsed. If synchronous machinery is running from the line, by building such machinery large for the work it has to do, it can be made to raise the voltage on the lines, as well as to diminish the lag, and thus perform the function of a booster; but the over-exciting of synchronous motors doing actual work, must not be pushed too far. The scheme of dividing a very high tension and long transmission line into sections at boosting sub-stations, is thought to prove exceedingly inconvenient in practice, and these sub-stations are believed to show themselves to be weak links in the system. While Forbes advocates the two-phase system of transmission rather than three-phase, it is said that the field of application of two-phase systems is very narrow and that such systems are only suitable for comparatively short transmissions, under 10 miles, where lighting forms the greater portion of the load; in all other cases, and particularly for long-distance transmissions, the three-phase system is thought to give the best results. The article concludes with a summary of the best practice of to-day in long-distance power transmission work; the use of a three-phase system, with no point connected to earth, gives the greatest economy and best results; the frequency should be not less than 40 nor more than 50 cycles; conversion to direct current should be made by means of motor-generators, preferably synchronous, if of large size; the high-pressure line currents should be generated directly in the stationary generator armatures; inductor alternators should be avoided, internally revolving field alternators with separately-driven exciters form the best arrangement; all three-phase generators ought to be so designed that the fall of pressure between no load and full load with constant speed and excitation will not exceed 15 per cent when the power factor of the load is 75 per cent or less; synchronous motors should be used for all large work, and generally as much as possible.—*Lond. Elec. Rev.*, May 4.

An abstract of the discussion which followed the paper of Forbes. Perry thought that Forbes, in recommending boosters for transmission lines, had possibly neglected the fact that the power developed in boosters costs money; to decrease the drop of voltage, either the amount of copper may be increased or a booster may be used; he found by calculations that, on the whole, the second method is not so economical as the first. Ferranti spoke in favor of motor-generators instead of synchronous converters, which he called "a very tricky thing." He considered the synchronous type of the motor-generator to be the best. He agreed with Forbes that the two-phase system, with the centre earthed, is very valuable, and that the best system for transmission need not be the best for distribution as well. He prophesied that the single-phase, low-frequency system would finally prove to be the best of all the systems; the whole of the details for this system were not yet quite complete; the only thing at present not quite perfect, was a single-phase, alternating-current motor; but such a motor is better than was generally supposed; the chief feature of this motor was its great simplicity, polyphase motors being much more complicated, and, therefore, more costly and troublesome; the use of the polyphase motor was largely a matter of fashion. Addenbrooke wished to correct the impression that lighting and power could not be done on a three-phase system without special transformation, and he pointed out that with motor-generators very large variations in the line pressure could take place, if the frequency remained the same, and yet one could get very good lighting. Hammond said that the real choice of systems at the present time lay between two and three-phase; in continental Europe the three-phase system is much in favor; there were, however, many cases where there were already large, single-phase works in existence, and also many cases where the network was made suitable for two-phase, stepped-up into single-phase, for instance, in Vienna. In his reply Forbes called Ferranti's remarks on single-phase motors, prophetical, and said that he might probably come to the same views.—*Lond Elec. Eng., Elec. Rev.*, May 4; *Lond. Elec.*, May 18.

A short editorial pointing out that Forbes' suggestion to reduce copper in a transmission line by placing boosters along the same at intervals, seems to be at fault, unless the power is distributed along the line rather than being collected as a whole at the end.—*Lond. Elec. Eng.*, May 4.

An editorial on Forbes' paper, discussing the advantages of different systems. While direct-current transmission is always by far the most economical in copper, when the pressure is within the limits of practice, beyond those limits for overhead transmission the three-phase system is no better in this respect than either single-phase, or two-phase with four wires. The two-phase system with common return may be regarded as out of the race for practical purposes. With the two-phase system one can run induction motors of the most satisfactory type, and drive rotary converters—which single-phase will not do with satisfaction—and provide for lighting, driving motor-generators or any other purpose equally well, while the separate phases constitute what is practically a duplicate service. With underground mains, however, for a power transmission direct from the generating station to a transforming sub-station, the three-phase system possesses an enormous advantage in point of cost. Further, when electric traction with polyphase currents is involved, although two-phase currents with a common return by the rails may be used, the three-phase system is more suitable.—*Lond. Elec. Rev.*, May 4.

An editorial criticizing several points of Forbes' paper. Regarding the booster scheme, it is said that the cost of the extra waste of energy which has to be taken account of when the cross-section of the conductor is reduced, plus the interest and depreciation on the cost of the line boosters for keeping up the pressure, has to be set against the saving in interest and depreciation in the conductors; and it is probable that this extreme measure of increasing the loss to over 50 per cent would only be resorted to in practice in rare instances of transmission over extremely long distances and for the most part in schemes whose realization is also far distant.—*Lond Elec.*, May 18.

Electric Power in Factories.—ALDRICH.—An abstract of a paper read before the American Society of Mechanical Engineers, on the systems and efficiency of electric transmission in factories and mills. In choosing a system, it is not necessarily best to select that one which will most readily lend itself to all of the work to be done, for light, heat and power service; the lighting service will, in general, be more satisfactory, and need not be more expensive, if supplied independently of the power service. A voltage over 550 should not be used. The special features of the continuous-current motor, the alternating-current induction motor, and the alternating-current synchronous motor are broadly discussed. In an ideal alternating-current system both induction and synchronous motors would be used, the former for small machines and direct driving, the latter for operating a group of machines. The synchronous motors would be started up just before beginning the work of the day, have at all times a light, constant load, and might easily be so regulated as to produce an almost balanced system in combination with the induction motors. The lagging currents of the induction motors would be offset by the leading currents of the synchronous motors, if the latter were operated to produce such leading currents. The group method of electric driving is much better adapted for small machines, up to and including 2-hp capacity, and especially where such machines are in almost constant service. Above this size, individual motor driving becomes more and more efficient, particularly if the machines are operated only a fraction of the day.—*El'ty*, May 23.

Electricity for Mining.—BENTHAN.—The conclusion of his illustrated paper (Digest June 2). He makes some remarks concerning motors and apparatus for starting, stopping and reversing them, and gives tables of comparison of the first costs and the efficiencies of a steam and an electric plant, together with a comparison of the working

costs. While the first cost is higher for the electric plant, the working expenses are smaller. In a table giving the results of one year's working for his special numerical example, he finds the interest on capital at 5 per cent to be $1,610 for the steam plant and $2,975 for the electric plant; the depreciation at 10 per cent per year, $3,220 and $5,950, respectively; the working expenses $23,950 and $18,338, respectively; so that there is a balance of $1,517 per year in favor of electric working. He then gives the reason why it is preferable to keep the colliery lighting quite independently of the power plant, and adds some brief remarks on the surface cables, the methods of wiring, the lamps and the lighting cables in the shaft.—*Lond. Elec. Eng.*, May 18.

REFERENCES.

Electric Motors for Hoisting Apparatus.—Niethammer.—A very long, illustrated French abstract of the German article noticed in the Digest Feb. 10, 17.—*L'Eclairage Elec.*, May 5.

Electric Cranes.—Vogelsang.—A paper read before the Electro-Technical Society of Cologne, on the moving mechanism of electric cranes, operated by several continuous-current motors. He gives a general mathematical outline of the questions involved, and discusses the construction of the controller. *Elek. Anz.*, Apr. 29, May 3.

Engines.—A long, illustrated description of quite a number of types of medium and slow-speed engines, filling nearly the entire issue.—*The Eng.*, May 15.

Improved Efficiency of Engines.—Josse.—An abstract of his paper on the device of Behrend and Zimmermann (Digest Jan. 6).—*Phys. Zeit.*, May 12.

Steam Plants.—Della Riccia.—A long article, illustrated by diagrams, on the consumption of fuel in steam plants for electric traction. The article of Herrick, noticed in the Digest Jan. 20, is abstracted and some general remarks are added on steam plants.—*L'Eclairage Elec.*, Apr. 28.

Water Power Plant.—Fawcett.—An illustrated description of the 60,000-hp power house at Sault Ste. Marie, Mich.—*Sc. Amer.*, May 26.

Crane.—An article on the garbage reduction at Cleveland, Ohio, which contains an illustration of an electric traveling crane for lifting the garbage boxes from the cars. Four of the eight wheels used to suspend the crane from an I-beam are driven. It has swivel trucks for rounding curves and a separate motor for vertical and horizontal travel, respectively.—*Eng. News*, May 31

Traction.

Distributing Systems for Electric Traction.—Sayers.—The first parts of a paper, illustrated by diagrams, read before the British Institution of Electrical Engineers on the calculation of distributing systems for electric traction under British conditions. After some introductory remarks, he says that when the distribution radii greatly exceed certain distances, a single station supplying direct current to the feeder system becomes impracticable and one of the following systems may be chosen: (1) the multiplication of generating stations retaining the direct-current, low-tension system of generation; (2) the use of battery sub-stations charged from a single generating station; (3) a single generating station, generating high-tension, polyphase current, with converter sub-stations. The second system seems to be limited to cases where an infrequent service is given on distant lines, and is, therefore, left out of consideration and the discussion is narrowed down to a comparison of the first and third system. There are two broad questions to be decided—first, what will be the total cost of producing a unit at the station or stations, and, second, what will be the total cost of getting a unit to the car? While every case requires special study to determine what advantage in generating costs is attainable by the adoption of the single large station, he says that a study of the distribution costs can be made on general principles, which will indicate what the saving must be in order to give the single station a balance of the advantage. He then takes up a numerical treatment of the question. General conclusions are not yet drawn in the present parts.—Lond. *Elec. Rev.*, May 11, 18; Lond. *Elec. Eng.*, May 18. The discussion, which followed the paper, is abstracted in *Lightning*, May 10 and Lond. *Elec. Rev.*, May 11.

Tomlinson.—An article on Sayers' paper, saying that it seems that Sayers was dealing with an actual case arising in practice for which he desired to ascertain the appropriate system, and that the general deductions which he draws, other than those obvious from general considerations of the inevitable extra loss involved, where electrical energy is generated in one form and transformed for use into another, were an afterthought. A comparison of the relative value of the general systems by starting from a particular case of demand is not fair. The method of working out the feeders, given in the paper, is said to be a good one.—Lond *Elec. Rev.*, May 11.

Automobiles.—Weber.—Some remarks on electric automobiles. If there is only one motor, he favors series parallel control by dividing the battery into two halves; the danger that one-half is discharged sooner than the other, and that, therefore, local discharges occur from one half into the other, is small, as the parallel connection is used only for short periods; a rheostatic control while all cells are in series, means waste of energy. He thinks that the scheme of some designers to divide the battery into four parts, goes too far. In the choice of a battery for an automobile, it should be considered that the cells, while being shaken on the road, give a smaller capacity than while at rest, which is somewhat surprising, as shaking causes a better circulation of the acid; the main causes of the decrease of capacity are, however, momentary overloads. He thinks that for reasons of safety a capacity 40 per cent higher should be chosen for automobile work than for work requiring the same energy while the battery is discharged at uniform normal rate, while at rest.—*Centralblatt fuer Accum. und Elem. Kunde*, May 1.

Single-Rail Tramway.—An illustration, with brief description, of the single-rail type, used in India and described in the Digest Jan. 13. The power is furnished by a storage battery. The truck is designed to carry a load of a quarter of a ton, and is capable of drawing two other trucks, each carrying a ton, at a speed of eight miles per hour. The single tracks for these railways are exceedingly economical to lay, and if laid near the edge of the road, encroach but little upon the driveway.—*Sc. Amer.*, June 2.

Paris Cabs.—An illustrated description of the electric cab system of Paris. The case containing the battery is supported underneath the frame of the vehicle, so that it may be easily replaced. The armature has two series of windings and two commutators, the field coils are also divided into two separate circuits, so that the speed may be regulated without changing the battery connections. The plant for recharging the batteries has two 132-kw dynamos.—*Sc. Amer.*, June 2.

Negative Boosters.—Two illustrated communications discussing what would be the best plant for arranging negative boosters on an extended system of tramways where several routes require having the current in the rails sucked backed, as it were, by such apparatus. It would not be satisfactory to have the negative feeders connected to a bus-bar which is supplied by one negative booster, but one negative booster should be supplied for each feeder, and it must be adjusted to meet the requirements of that feeder.—Lond. *Elec. Eng.*, May 18.

REFERENCES.

Three-Phase Railway.—Thomanu.—A very long, well-illustrated description in detail, of the line of Burgdorf to Thun, which has been noticed in the Digest repeatedly.—*Schweiz. Bauzeit.*, v. 35, No. 1 to 7; abstracted at some length, with numerous diagrams, in *L'Eclairage Elec.*, May 12.

Accumulator Traction.—Krizik.—A French abstract of the German article noticed in the Digest Dec. 2.—*L'Eclairage Elec.*, May 5.

Tramway Systems.—Jean.—A statistical comparison of the cost of first installation and of operation for different systems of tramways in France.—*Genie Civil*, v. 36, p. 6, 21, 38; a rather long abstract, in which it is said that the conclusions of the article are not favorable enough to electric traction, in *L'Eclairage Elec.*, May 5.

Calculation of Electric Tramways.—Fekl.—A very long, illustrated French abstract of the German article noticed in the Digest Oct. 14.—*L'Eclairage Elec.*, Apr. 7.

Electric Traction on Existing Railways.—de Segundo.—An article of a rather general nature, discussing broadly the questions arising in schemes for applying electric traction to existing railways, especially to suburban traffic. The article does not seem to contain anything new.—Lond. *Elec. Rev.*, May 11, 18.

Electric Traction in the Country.—Schiemann.—An article on the construction and the importance of electric railways and automobiles for agricultural and industrial purposes in the country and in smaller towns. After a general discussion of the conditions which make electric traction profitable in the country, where there is a small passenger traffic but a large freight traffic, he gives illustrated descriptions of special arrangements for loading freight cars of broad-gauge trunk

railroads upon cars running on narrow-gauge tracks of light electric railways.—*Elek. Anz.*, May 6.

Surface Contact System.—A brief description of a system devised by Hillischer, which is to be tried on an experimental line in Vienna.—*Elec. Tech.*, Apr. 30.

Surface Contact System.—HEINA.—An illustrated description of the Paul system, used by Schuckert, on a line in Munich with good success.—*L'Eclairage Elec.*, Apr. 14.

Automobile.—DELASALLE.—A description of the Creanche automobile. The series motor gives 1 kilowatt at 1200 revolutions and 90 volts. The armature has two windings and two collectors. Four different speeds can be obtained.—*La Locomotion Aut.*, Mar. 8; briefly abstracted in *Le Mois Scient.*, April.

Automobile.—REYVAL.—An illustrated description of the Berthier electric automobile, which has a motor with both field and armature revolving, the first driving one axle, the second the other. A speed reduction of one-half is thereby accomplished, and a single motor may then be used to drive both wheels nearly independently.—*L'Eclairage Elec.*, Apr. 21. Another description of the same automobile in *La Machine* (Geneve), Feb. 25; abstracted in *Le Mois Scient.*, March.

Railway Brakes.—BARBILLION.—An illustrated article on electromagnetic railway brakes, especially that of Schiemann, described in the Digest Aug. 19.—*L'Eclairage Elec.*, Apr. 21.

Norwich.—The first part of a long, well-illustrated description of the new electric tramway lines of Norwich. The length of the line is 20 miles; the trolley system is used; the station has a capacity of 1280 horse-power.—Lond. *Elec.*, May 18.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Paris.—LAFFARGUE.—A very long statistical article on the distribution of electrical energy in Paris on Jan. 1, 1900, including a map and tables covering more than 12 full, large pages, giving a large amount of information on central stations, the distribution lines, the different applications of electric power and the financial results of operation. The total power installed in the central stations was 1766 kilowatts in 1889 and 24,790 kilowatts in 1899. The number of arc lamps was 467 in 1889 and 12,840 in 1899; the number of incandescent lamps 20,168 and 876,102; the total number of lamps, in terms of 10-cp lamps, 27,372 and 1,183,099, which gives a total power of 908 kilowatts and 41,656 kilowatts, respectively. The total power of motors installed was 0 in 1889 and 4844 kilowatts in 1899. The number of apparatus installed for electric heating, etc., was 0 in 1889 and 65 in 1899, with a power of 183 kilowatts. The total power for lighting, power and heating installed was therefore 908 kilowatts in 1889 and 46,683 kilowatts in 1899. The total electrical energy distributed in 1889 was 480,984-kw-hours and 17,492,267-kw-hours in 1899; the total receipts were $120,572 in 1889 and $3,354,710 in 1899; the average price of the kw-hour, $0.25 in 1889 and $0.19 in 1899; the total number of consumers, 216 in 1889 and 19,815 in 1899.—*L'Ind. Elec.*, May 10.

Electric Furnaces Supplied by Polyphase Currents.—A description of a method of Schuckert & Company for connecting electric arc furnaces supplied by polyphase currents. The fixed electrodes placed at the bottoms of several furnaces are connected together and with the earth, while the other, upper, movable electrodes are connected each with a feeder of the polyphase current supply; the number of the furnaces is equal to the number of phases. The advantages of this arrangement are briefly explained.—*Zeit. fuer Elektrochemie*, May 3.

India.—A note stating that the Port Commissioners of Calcutta have resolved to install electric power for trimming coal on vessels at docks; the plant will be capable of trimming 320,000 tons of coal per year, with a saving of 45 per cent of its capital cost. In Colombo, Ceylon, the railway yard is to be lighted electrically.—Lond. *Elec. Eng.*, May 18.

REFERENCES.

Relay.—An illustrated description of a differential relay for alternating currents of the General Electric Company, of Berlin, for operating automatically a commutator or a regulator.—*Elek. Rund.*, Nov. 15; *L'Eclairage Elec.*, Apr. 21.

Electricity on Board Ship.—EHNERT.—An illustrated article on the use of electricity on ship board, especially for lighting purposes. The methods of wiring are discussed and some remarks are added on the use of electric motors.—*Elek. Anz.*, May 10, 13, 17.

Isolated Plant.—SCHINDLER.—An illustrated description of the power station, containing a 33-kw dynamo, a 5½-kw dynamo and a battery giving 300 ampere-hours if discharged in three hours, for lighting and power purposes in a German lithographic house.—*Elek. Anz.*, Apr. 26.

Coventry.—An illustrated description of the Coventry municipal electric plant, which has already been referred to in the Digest.—Lond. *Elec. Rev.*, May 18.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Cable Breakdowns.—KAPP.—A long, illustrated French abstract of the German article noticed in the Digest Jan. 20.—*L'Eclairage Elec.* Apr. 21.

Cable Manufacturing.—An illustrated description of Rickard's cable factory at Derby.—Lond. *Elec. Rev.*, May 18.

Testing Underground Mains.—A communication describing a routine method of testing a system of underground mains, the instruments necessary, and a method of keeping the records.—Lond. *Elec. Eng.*, May 18.

Localizing Defects in Cables.—PROBST.—A long, illustrated description of a method for localizing the defects in concentric or twisted, iron-armored cables, with an induction coil and a telephone. To get induction currents, it is necessary to send current either only through one of the two conductors of the cable, or to supply different currents to both conductors. His method requires the resistance of the defects to be zero, which can be easily accomplished. The method, which has been in successful use in Vienna, is described in detail.—*Zeit. fuer Elek.*, Apr. 29.

ELECTRO-PHYSICS AND MAGNETISM.

Coherers.—BRANLY.—A French Academy paper on the variation of the resistance of coherers. The increase of the resistance which he observed as early as 1891 in certain coherers, is much rarer than the diminution of the resistance. He made new experiments which confirm his opinion that the increase of the resistance, as well as the diminution, depends upon a physical state of the interposed insulating layer. He studied the two effects separately by attributing to them equal importance, in a similar way as the magnetic and the diamagnetic phenomena are studied separately, with which the diminution and the increase of resistance have some analogy. He has made two series of experiments with substances with decreasing and with increasing resistances. These experiments are described, but no general conclusions are drawn.—*L'Elec.*, May 12; more briefly in *L'Ind. Elec.*, May 10.

Electrostatic Deviation of Cathode Rays.—VILLARD.—A French Academy note, describing an experiment, first made by Jaumann, with a cathode-ray tube in oil. The bundle of cathode rays was momentarily attracted, when a positively-charged body was approached, and was momentarily repulsed when a negatively-charged body was approached. He adds some explanatory remarks on the action of the oil.—*Comptes Rendus*, v. 130, p. 1177; abstracted in *L'Eclairage Elec.*, May 12.

Absorption of Radium Rays.—VILLARD.—A French Academy note on experiments showing that glass of the thickness of 1 cm absorbs practically all the rays which are apt to be refracted, and lessens very slightly those which are not apt to be refracted; the former cannot pass through a lead plate of 0.3-cm thickness, while the latter are only lessened by the passage.—*Comptes Rendus*, v. 130, p. 1178; abstracted in *L'Eclairage Elec.*, May 12.

REFERENCES.

Unipolar Induction.—POINCARE.—A long article referring to the experiments of Nicolaieve and to the paper of Raveau (Digest Sept. 9, Nov. 4, Mar. 10). He gives an analytical theory of the respective questions.—*L'Eclairage Elec.*, Apr. 14.

Dielectrics.—SACERDOTE.—An article in which he gives a summary of his researches on the electric deformations of the isotrope solid dielectrics (as promised in his preliminary paper, noticed in the Digest Oct. 7).—*L'Eclairage Elec.*, Apr. 7.

Crystallization of Metals by Electrolysis.—TOMMASINA.—A German translation of the French Academy paper, abstracted in the Digest Mar. 31.—*Phys. Zeit.*, May 5.

Coherer.—Campanile and Ciomme.—A German translation of the Italian note, noticed in the Digest Apr. 28.—*Phys. Zeit.*, May 19.

Automatic Coherer.—Tommasina.—A German translation of the French paper abstracted in the Digest June 2.—*Phys. Zeit.*, May 5.

Resistance of Gases.—Kaufmann.—A brief note pointing out that the so-called "resistance" of conducting gases is not well defined, but that greatly different values may be obtained with different methods of measurement.—*Phys. Zeit.*, May 12.

Ionization of Gases.—Langevin.—A long abstract of a French Physical Society paper giving an outline of J. J. Thomson's theory.—*L'Eclairage Elec.*, Apr. 28.

Ions in Gases.—Townsend.—A theoretical article giving an outline of a theory of the diffusion of ions in gases.—*Phys. Zeit.*, Apr. 14.

Luminosity of Rarefied Gases.—Borgmann.—A French Academy note on the phenomenon that a bare metallic wire is surrounded by a luminous aureole, when inserted into the circuit of a Rhumkorff coil, containing a spark gap or a Crooke's tube. He investigated the case of wires in glass tubes of different lengths and different diameters, with different degrees of rarefaction of the gases in the tubes.—*Comptes Rendus*, v. 130, p. 1179; abstracted in *L'Eclairage Elec.*, May 12, *L'Ind. Elec.*, May 10.

Effect of the Temperature upon the Electric Illumination of Rarefied Gases.—Stark.—A summary of the physical results of his investigations described in his paper, which was noticed in the Digest Sept. 23, and in the two papers, noticed in the Digest Mar. 31.—*Phys. Zeit.*, May 19.

Radium Rays.—Dorn.—A note describing experiments proving that there is an influence of an electric field upon radium rays, analogously with the behavior of cathode rays.—*Phys. Zeit.*, May 5.

Photoelectric Cathode Rays.—Merritt and Stewart.—An illustrated preliminary note, in which they describe experiments proving the magnetic and electrostatic deviation of the photoelectric cathode rays and the ionization of the air produced by them.—*Phys. Zeit.*, May 5.

Geissler Tubes.—Dongier.—An abstract of a French Physical Society paper on the polarization of the light emitted from a Geissler tube, which is exposed to the action of a magnetic field normal to its axis.—*L'Elec.*, May 12.

Magneto-Optics.—Corbino.—Two notes, in the second of which he describes experiments from which he concludes that Sheldon's phenomenon is non-existent.—*Nuovo Cimento*, 10, p. 408; a German translation in *Phys. Zeit.*, Apr. 7.

Zeeman Phenomenon.—Righi.—A long, German abstract of a paper read before the Academy of Science of Bologna, on the Zeeman phenomenon in the general case of a light ray inclined at any angle with the direction of the magnetic force.—*Phys. Zeit.*, Apr. 28.

Electro Chemistry and Batteries.

Lead Accumulator.—Nernst and Dolezalek.—A brief contribution to the theory of the lead accumulator. If dilute sulphuric acid is electrolyzed between platinum electrodes, there is a slight development of gas at both electrodes at 1.7 volts and a vivid one at 1.9 volts. From this fact it might be (wrongly) concluded that it is impossible to construct with aqueous solutions an accumulator, the e. m. f. of which is above 1.7 volts, as at this voltage the electrolyte is decomposed. If, however, the platinum electrodes are replaced by lead electrodes, a current which continues, is obtained at a pressure not below 2 volts, and the products of electrolysis are not hydrogen and oxygen, but lead and peroxyde of lead; not until after all the sulphate of lead has been changed does a development of gas occur at about 2.3 volts. The formation of lead and peroxide of lead from sulphate of lead occurs in this case at a considerably smaller voltage than the decomposition of water. The electrolysis, therefore, yields not that one of the possible products which requires the smallest amount of energy, but the one which requires more energy, namely, lead and peroxide of lead instead of oxy-hydrogen gas. An explanation of this peculiar behavior of lead, which enables one to construct an accumulator of 2 volts, can be given by means of the recently-developed theory of the generation of hydrogen on metals (experimentally proved by Caspari, as described in the paper by Coehn, Digest Aug. 26, Sept. 2, 1899), acording to which the minimum e. m. f. necessary for the decomposition of an electrolyte, must be increased by an additive term which relates to the specific property of the material of the electrode (Caspari's "surplus pressure"), and which is greater the smaller the quantities of hydrogen which the metal of the electrode is capable of absorbing, as can be deduced with some probability from the experiments. It appears, therefore, that the energy, required for the development of hydrogen at a metallic surface, decreases rapidly with the capability of occluding hydrogen. But a great number of experiments have shown that lead is comparatively much less capable of occluding hydrogen than other metals; therefore, the energy required for the development of hydrogen is considerably greater at lead plates than at platinum plates; hence, if dilute sulphuric acid containing sulphate of lead is electrolyzed, not hydrogen, but lead, is formed. By a simple experiment, which is described, they prove the correctness of their argument. The rapid increase of the e. m. f. of the accumulator at the end of a charge, is explained as follows: During the period of charging, solid sulphate of lead in fine-powdered form is always present at the electrodes, the acid being saturated with sulphate; at the end of the charge, nearly all solid sulphate of lead accessible to the action of the current is consumed, and, therefore, the sulphate contained in the solution is rapidly electrolyzed, so that the concentration of the lead ions decreases and the e. m. f. rapidly increases; very soon, however, the solution of lead is so dilute that the energy necessary for the decomposition of lead becomes equal to that for the development of hydrogen on a lead plate, and then hydrogen and not metallic lead is formed. Measurements of Streintz are quoted to prove this theory. When the overcharged accumulator is left at rest on open circuit, a diffusion of lead sulphate occurs from the interior through the pores of the plates, the sulphate being always present in the charged cell also, and thus the e. m. f. decreases rapidly to the normal value. It may, therefore, be assumed as certain, that the high voltage at the end of the charge is caused by the formation of a lead sulphate concentration cell in the accumulator. The peculiar influence of mercury salts can also be easily explained, as according to Caspari the development of hydrogen at a mercury surface is even more difficult than at a lead surface; therefore, an amalgamation of the lead plate is the cause of the fact that the development of hydrogen starts at a higher voltage, so that a greater part of the active mass can participate in the chemical processes, which produce an increase of the capacity, as experimentally found.—*Zeit. fuer Elektrochemie*, May 10.

Electric Process of Making Alcohol.—An article on the Villon process of making ethyl alcohol from acetylene, as noticed in the Digest Dec. 30. There is added a U. S. consular report of Gowdy, discussing several methods of manufacturing alcohol from acetylene and concluding that "among these various methods, some are of great value to demonstrate in the laboratory a synthesis of alcohol, but at present none of the methods can actually be employed for industrial or manufacturing purposes at a remunerative cost price; it is indisputable, however, that if one of these methods could be practically applied, it would produce a revolution in the alcohol industry;" also an apparently older, unfavorable remark of Prof. Maercker and a note from the *Metall. Chemische Revue* on a method of changing common, low-grade spirits into absolutely pure alcohol by means of calcium carbide. The writer of the present article says that, in view of the absence of exact information on the subject, the unfavorable opinions of some of the authorities may justly be considered as not entirely conclusive, and it is still to be proved that a process cannot be perfected that will be commercially profitable at the prevailing prices of the elements entering into the manufacture of the finished article.—*Eng. News*, May 31.

Batteries.—A brief description of two recently patented cells. The one, devised by Poppenberg, has a carbon and a zinc electrode, resting upon a porous plate, the space between this plate and the bottom of the cell being filled with sulphate of soda; when water is put into the upper part of the cell, the salt is dissolved and passes through the diaphragm; the strength of the electrolyte is said to be thus rendered nearly constant. The other cell, devised by Michalowski, has nickel covered with sesquioxide of nickel and zinc as electrodes in an alkaline solution; the feature is the use of sesquioxide of nickel as depolarizer.—*Sc. Amer.*, June 2.

Lead-Peroxide Zinc Cells.—Mueller.—An article on a cell which is in the market under the name of "transportable electricity." The positive electrode is a lead-peroxide plate, containing the electrolyte in concentrated form; the negative electrode is a zinc plate; to start a cell, both plates are placed into water. The scheme is to erect regeneration stations all over the country where the lead-peroxide plates are "regenerated." The electrolyte is not regenerated, so that the cost of operation are the price to be paid for the exchange of a

discharged lead-peroxide plate by a "regenerated" one, plus the price of the zinc consumed. Pure zinc is required for good operation. He claims that the price of a kw-hour will be between 30 and 37½ cents. —*Centralblatt fuer Accum. und Elem. Kunde,* Apr. 15, May 1.

Electrolytic Production of Ozone.—TARGETTI.—An account of experiments made to find the conditions most favorable to the production of ozone by the electrolysis of a solution of sulphuric acid. The best solution has a specific gravity of 22 degs. Baumé; an anode of lead yields an output about 50 per cent more than one of platinum; the quantity of ozone developed per unit of electric energy increases with the current density at the anode and grows also if a jet of air is blown upon the anode. With a current of 2 amperes at 7.4 volts, the quantity of oxygen developed in 10 minutes is about 10 mmgr., the percentage of ozone can attain 9—that is, more than the double of the maximum output obtained so far. In spite of this favorable efficiency, the development of ozone by electrolysis has not been used in practice so far.—*Il Nuovo Cimento,* November; abstracted in *L'Eclairage Elec.,* May 12.

Electric Tanning.—An article describing a method of Zerener, who sends continuous current through the tanning vats, the direction of the current being perpendicular to the surfaces of the skin and being reversed every 15 seconds. In this way he prevents the changing of tannic acid into gallic acid and claims to accelerate the process of tanning.—*Elektrochem. Zeit.,* May.

REFERENCES.

Lead Accumulator.—MUGDAN.—A long, French abstract of the German article, noticed in the Digest Jan. 13.—*L'Eclairage Elec.,* Apr. 28.

Accumulators.—HELBIG.—An account of an experimental investigation of the chemical nature of the gases emanating from accumulators.—*L'Elettricista,* December; abstracted in *L'Eclairage Elec.,* May 5.

Softened Accumulator Plates.—PETERS.—An English translation of the German article, abstracted in the Digest Apr. 28.—Lond. *Elec.,* May 18.

Lead Accumulator.—DOLEZALEK.—A correction of a theoretical inaccuracy in one of his former papers on the theory of the accumulator.—*Zeit fuer Elektrochemie,* May 17.

Electrolysis.—DEWAR.—A brief abstract of the third of his lectures on a century of chemistry at the Royal Institution, in which he dealt with some chemical investigations of Davy and Brande and also with Farday's work on electrolysis.—Lond. *Elec.,* May 18.

Ionization Theory.—ROTHMUND.—A theoretical paper on the e. m. f. and chemical equilibrium.—*Zeit. fuer Phys. Chem.,* v. 31, p. 69; abstracted in *Zeit. fuer Elektrochemie,* May 17.

Electrolysis of Alkaline Chlorides.—WINTELER.—A French translation of the German paper noticed in the Digest Aug. 6 and Sept. 10, 1898.—*L'Ind. Elec.-chim.,* February, March.

Electrolytic Analysis.—A French Academy note on the electrolytic analysis of lead in the sulphate and chromate.—*L'Elec.,* May 12.

Preparation of Saturated Solutions.—VAN'T HOFF.—A long, illustrated French abstract of the German Electrochemical Society paper noticed in the Digest Sept. 2.—*L'Eclairage Elec.,* Apr. 21.

Synthesis of Organic Substances.—DONY-HENAULT.—The first of several illustrated papers on the synthesis of organic substances by electrolysis, describing the method of his measurements, and dealing mainly with the oxidation of methyl alcohol and ethyl alcohol and the analogy between chemical and electrochemical oxidants.—*Zeit. fuer Elektrochemie,* May 3.

Electrolysis of Organic Bodies.—SCHALL.—A French abstract of the German Electrochemical Society paper noticed in the Digest Sept. 2.—*L'Eclairage Elec.,* Apr. 21.

Electric Process of Making Alcohol.—A description of a process devised by Magnier and Brangier, for obtaining ethyl alcohol from wood by an electrolytic method. The cellulose of the wood is transformed into dextrine, glucose and finally into alcohol. The single parts of the process are briefly described.—*Sc. Amer.,* May 26.

Sugar Industry.—An article describing improvements in the electrochemical processes of the sugar industry. The article is chiefly of interest to chemists.—*L'Ind. Elec.-chim.,* v. 3, p. 51; abstracted in *Elektrochem. Zeit.,* May.

Electrolytic Zincing.—QUIVY.—An abstract of a brochure, in which he describes a small installation for electrolytic zincing.—*L'Ind. Elec.,-chim.,* March.

Industrial Electrolysis.—GUILLET.—An article on the present conditions of the production of chemical materials by electrolysis. An outline of different processes and a statistical table of chlorine plants are given.—*Le Genie Civil,* Dec. 2, 9; abstracted in *Le Mois Scient.,* April.

Electro-Chemistry.—A review of the most prominent electro-chemical plants of the world.—*Chem. Trade Jour.* (Manchester), Jan. 20; in form of a table in *Le Mois Scient.,* April.

Statistics of the Electro-Chemical Industry.—BORCHERS.—A very long, French abstract of the German paper, abstracted in the Digest Aug. 26.—*L'Eclairage Elec.,* Apr. 21.

Germany.—A list of the changes in the firms in the electro-chemical industry of Germany in 1899, and the new firms.—*Zeit. fuer Elektrochemie,* May 10, 17.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Wehnelt Interrupter.—RUHMER.—An article referring to an assumption in Simon's theory (Digest July 15, 1899), namely, that for the first approximation an average value of the resistance of the interrupter may be regarded as constant. He describes experiments showing that the resistance of a given interrupter is not constant, but a function of the current and of the self-induction; it decreases with increasing current and increases with decreasing self-induction. If other things are kept equal in the circuit, only the surface of the platinum anode being increased, and if then the current density per unit of surface is calculated from the current, the current density will be found to decrease; to keep the latter constant, it is necessary to diminish not only the resistance, but also the self-induction by 50 per cent. Any interrupters, for which the current density is the same, have the same frequency.—*Phys. Zeit.,* Apr. 7.

Wehnelt Interrupter.—HEINKE.—An article criticizing the above note by Ruhmer. The resistance of the Wehnelt interrupter is a periodic function of time; if an average value is to be introduced instead of the varying instantaneous values, it is necessary to give a sharp definition of the average value; he gives definitions of three different average values, of which the value, used by Ruhmer, is not one. He shows that Ruhmer's experiments do not prove anything in favor of or against Simon's supposition.—*Phys. Zeit.,* Apr. 28.

Producing Phase Differences.—A description, illustrated by diagrams, of a device of Siemens & Halske, by which in the diagonal wire of a Wheatstone bridge, an alternating current is obtained, the phase of which has any desired phase difference compared with the given alternating current of the supply. The energy consumed in the other four wires of the bridge is made a minimum. One set of two opposite wires of the bridge contains mainly self-induction; the other set of opposite wires contains mainly condensers.—*Elek, Rund.,* May 15.

REFERENCES.

Measuring Instruments.—ARMAGNAT.—Brief, illustrated descriptions taken from patent specifications, of the galvanometer of Flower and Gambrell, the electrometer of Addenbroke, the galvanometer of Blackburn and Spence, the voltmeter of Heap, a device of Siemens & Halske for the use of transformers with wattmeters, and the galvanometer of Davis and Conrad.—*L'Eclairage Elec.,* Apr. 28.

Meter.—Well-illustrated descriptions of two new meters for different rates, one devised by Aron, the other by Fahn.—*Zeit. fuer Beleucht.,* Apr. 30, May 10; another illustrated description of the Aron meter in *Elek. Rund.,* May 15.

Wattmeter.—KALLIR.—An illustrated article on the compensation of two influences which give rise to the fact that in a wattmeter, based upon the electrodynamometer principle, the power to be measured is not exactly proportional to the angle of torsion. He gives an analytical theory and shows how to calculate and arrange compensation coils, to get exact proportionality.—*Zeit. fuer Elek.,* May 6.

Wehnelt Interrupter.—FEDERICO AND BACCEI.—An account of an experimental investigation of the action of the interrupter with an optical method by the aid of photography.—*Rendiconti dei Lincei,* Dec. 17.

CORBINO.—Some theoretical notes, in which he remarks that the formula of Simon (Digest July 15) is not entirely satisfactory; also an account of some interesting experiments. Other experiments are described in a second article.—*Rendiconti dei Lincei,* Dec. 17.

These articles are abstracted with illustrations in *L'Eclairage Elec.,* Apr. 7.

Measuring Reaction E. M. Fs.—MUELLER.—An illustrated description of a method for using the capillary electrometer for measurements of the e. m. fs. at which certain reactions in electro-chemical experiments start.—*Zeit. fuer Elektrochemie,* May 3.

Photographic Current Curves.—Zenneck.—An illustrated, French abstract of the German paper noticed in the Digest Feb. 3, with some of the photographs of the curves.—*L'Eclairage Elec.*, May 12.

Photographing Current Curves.—Wehnelt and Donath.—An illustrated French abstract of the German paper noticed in the Digest Feb. 3. Several of the photographs are reproduced.—*L'Eclairage Elec.*, May 12.

Analysis of the Higher Harmonics of Alternating Currents.—Zenneck.—An illustrated, French abstract of the German paper noticed in the Digest Jan. 27.—*L'Eclairage Elec.*, May 12.

Telegraphy, Telephony and Signals.

REFERENCES.

London.—The conclusion of the illustrated article on the telephoning of London by the post office (Digest June 2), giving information about the jointing-chambers, the switchboards, the central battery system and the rates.—Lond. *Elec. Rev.*, May 18.

Italy.—A discussion of the new proposed law for the telephone service in Italy.—*L'Eclairage Elec.*, Apr. 21.

Miscellaneous.

Silicide of Iron.—G. K.—A description of a process of producing ous earth in the electric furnace. Silicides of iron, especially when possessing a high percentage of silicium, have a considerable resistance against mechanical and chemical attacks; it is said that the latter property and its good electric conductivity may make it useful for electrodes instead of platinum, which is much more expensive.—*Ungar. Metallurbeiter*, March 30; briefly abstracted in *Le Mois Scient.*, April.

Hardening Steel Ware.—A note on a method devised by Hammesfahr, to prevent the oxidation and the warping of steel ware during the process of hardening. This is accomplished by electroplating the object, before the hardening, with nickel, copper or other convenient metals or metallic alloys.—*Elektrochem. Zeit.*, May.

REFERENCES.

Electric Soldering Irons.—A well-illustrated description of some recent types, taken from patent specifications.—*L'Eclairage Elec.*, March 24; a German translation with illustrations in *Elek. Anz.*, Apr. 26.

Manufacturing Plant.—The first part of a well-illustrated description of Ferranti's Hollinwood plant. The way in which the various parts of the Ferranti meter are made and assembled is described, and illustrated descriptions are given of the modern forms of Ferranti alternators with stationary armature and with revolving armature.—Lond. *Elec. Eng.*, May 18.

Electrical Society.—An account of the proceedings of the general meeting of the Electrical Society of Vienna. Volkner was elected president. A long report was delivered by Wueste on the projected Austrian electrical exposition in 1903.—*Zeit. fuer Elek.*, Apr. 29.

Paris Exposition.—An illustrated description of a 3000-kw, three-phase generator of the General Electric Company, of Berlin, exhibited there.—*Elek. Zeit.*, May 17.

Farrington.—An illustrated article on the U. S. mining exhibit.—*Eng. & Min. Jour.*, May 26.

A reprint of the official preliminary programme of the International Electrical Congress.—*L'Ind. Elec.*, May 10.

New Books.

Modern Electric Railway Motors. A Discussion of Current Practice in Electric Railway Motor Construction, Maintenance and Repair. By Geo. T. Hanchett, S.B. New York: Street Railway Publishing Company. 200 pages, 157 illustrations. Price, $2.00.

This is a welcome addition to the meagre literature of the electric railway, giving as it does an account in much detail of the most essential factor in electric traction—the car motor. The treatment, moreover, is entirely practical, and while all the types of electric railway motors are adequately described, the descriptions refer particularly to essential details, and differences are brought out by comparisons between the several types.

The first chapter relates to forms of field magnets and their circuit connections, and includes a discussion of the advantages and disadvantages of the various forms of fields. The second chapter considers armature-winding diagrams, giving the elementary principles and discussing the proper distribution of current-carrying wires. The following six chapters take up the details of motor construction, being devoted respectively to field-coil construction and arrangement, armature construction, commutators and brush-holders, motor casings, motor suspensions and bearings, and gears. Each of these subjects is developed from a practical standpoint and much information of value to the repairman is given concerning forms for coils and winding manipulation. The chapter on commutators and brush-holders is particularly useful from the information given as to the maintenance of commutators. A chapter deals with the relative advantages of different kinds of lubricants and gives recipes for compounding lubricants. A valuable chapter is on management and repair, including methods of inspection in repair shops and car barns, and concluding with a section giving instructions for motormen. The final chapter of the book is on the design of a street railway motor, in which such a design is worked out numerically.

The book includes a table giving the principal dimensions of all types of street railway motors now in general use, both American and foreign. The data consists of horse-power, speed, reduction ratio, number of poles and field coils, total field turns, number of slots and conductors per slot; number of commutator bars and bands, weight of armature, gears and casing, and complete motor; dimensions of commutator and pinion bearings, diameter and length of armature, sizes of field and armature wires, and remarks as to the kind of winding, etc.

The book appeals equally to the electric railway man seeking instruction concerning points involved in his daily work, and to the student in completing his information concerning both the principles and practical details of the electric motor.

Fortschritte der Elektrotechnik. Zehnter Jahrgang, 1896, Viertes Heft. Dreizehnter Jahrgang, 1899, Zweites Heft. Berlin: Julius Springer.

The latest issues of this quarterly report on the more recent phenomena in the entire province of electrical science, by Dr. Karl Kahle, consists of the fourth number of the year 1896 (pp. 555-827) and the second number of the year 1899 (pp. 249-481). This well-known and valuable periodical forms an excellent compendium of the literature of the electric arts, and now extends over a period of nearly thirteen years. Each year's compilation contains some 5000 references to printed publications, principally in English, French and German languages, together with a number of brief reviews of the progress in each direction. The work is tabulated under five heads: A.—Electro-mechanics. B.—Electro-chemistry. C.—Electric Signal Apparatus. D.—Measurements and Scientific Researches. E.—Earth Current and Atmospheric Electricity.

These are again divided into 18 classes and the classes are finally sub-divided into nearly 100 sub-classes. The work has been carefully and intelligently performed, and the entire set has great value to the student in particular, as well as to all who are interested in the history and development of the electric sciences and arts. A large proportion of the references are to works in the English language. Thus, taking the first class of "Dynamos and Motors" in the second number of 1899, out of 152 references, 115 are to literature in the English language, 27 to German and 10 to French. At the conclusion of each annual volume appears a tabulated list of authors of the references for that year, as well as a tabulated list of subjects. Until recently this periodical was almost the sole reference for tabulated electrotechnical literature.

The Steam Engine Indicator. By Cecil H. Peabody. New York: John Wiley & Sons. 153 pages, 98 illustrations. Price, $1.50.

There are two classes of works on the indicator—one written by the "practical" man who, in a desire to appear scientific, deals in theory he does not understand and delights in "theoretical" geometrical constructions which are absurd. The second class consists of works—usually written by competent authorities in steam engineering—which present the steam engine indicator and its applications in a manner which accords both with the simplicity of the appliance and its easily understood applications.

The present work is of the latter class and can in confidence be recommended both to the practical man and the student of steam engineering. The indicator and its various attachments are explained in detail with reference to excellent illustrations. The errors of the indicator are treated at length, this section forming a valuable part of the book. The interpretation of indicator cards and the combina-

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tion of multiple expansion cards are considered with reference to reproductions of actual cards. The planimeter is explained with respect both to principle and operation. The various calculations from indicator data are illustrated by examples, the principles involved being made clear by simple statements of theory. An appendix gives tables of areas of circles, properties of saturated steam, heat of the liquid, and logarithms.

TRANSACTIONS OF THE PACIFIC COAST ELECTRIC TRANSMISSION ASSOCIATION. Report of Proceedings of the Third Annual Convention, June 20-21, 1899. San Francisco: Offices of the Association. 115 pages, illustrated.

The papers contained in this report are as follows: Tests and Calculations for a Forty-Mile Aluminum Wire Transmission Line, by Prof. F. A. C. Perrine; Hints on Long-Distance Transmission, by R. W. Van Norden; Electric Lighting vs. Gas, by Jno. Martin; Regulation of Alternating-Current Generators, by Prof. C. L. Cory; Electrically-Driven Centrifugal Pumps, by Lewis A. Hicks; On the Determination of a Fair Return for Current Supply, by C. W. Hutton. The paper by Dr. Perrine gives the result of tests on the Blue Lake line, which is subjected to 25,000 volts. The line was tested for resistance capacity and inductance, which quantities were also calculated from line data. The discussion on most of the papers was extensive and instructive, the members giving freely the results of their experience. The report shows, indeed, a highly flourishing condition of this association, which should be of much benefit to its members in view of the special character of the many Pacific slope transmission plants.

BOOKS RECEIVED.

TRANSFORMATOREN FUR WECHELSTROMUND DREHSTROM. Eine Darstellung ihrer Theorie, Konstruktion und Anwendung. Von Gisbert Kapp. Zweite ver mehrte und verbesserte auflage. Berlin: Julius Springer. 282 pages, 165 illustrations. Price, 8 marks.

DIE ELEKTRISCHEN BAHNEN. By Dr. Max Corsepius. Stuttgart: Verlag Von Ferdinand Enko. 182 pages, 89 illustrations.

A BRIEF HISTORY OF MATHEMATICS. By D. Karl Fink. Chicago: The Open Court Publishing Company. 338 pages. Price, $1.50.

Directory of Electrical Societies, Etc.

NORTHWESTERN ELECTRICAL ASSOCIATION. Next meeting, Waupaca, Wis., June 26, 27 and 28, 1900.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Kansas City, Mo., Oct. 16, 17, 18 and 19, 1900.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Pittsburg, Pa., Sept. 25, 26 and 27, 1900.

AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Next meeting, New York, Sept. 25, 26 and 27, 1900.

INDEPENDENT TELEPHONE ASSOCIATION, Cleveland, Ohio, June 12-14, 1900.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, Paris, Aug. 16, 1900.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, September, 1900. Place to be selected.

ASSOCIATION OF RAILWAY TELEGRAPH SUPERINTENDENTS. Next meeting, Detroit, Mich., June 20, 21 and 22.

Westinghouse Apparatus for Charging Automobiles.

Since New York has taken the lead in abolishing horse-drawn cabs in favor of automobiles, the use of the latter is rapidly extending in other cities. A drawback to a more extensive use of automobiles is the fear lest the current should become exhausted at a distance from a recharging station. To facilitate the provision of stations for recharging batteries, the Westinghouse Electric & Manufacturing Company has designed a very complete outfit, by which current can be taken from alternating-current circuits and converted into direct current for charging storage batteries.

The outfit consists of three elements—a rotary converter, two auto-transformers (one in each phase) and a switchboard. This outfit illustrates the advantage of having the various elements of a combined set of apparatus harmonize properly. Two-phase alternating currents at 7200 alternations, at a voltage of 100 to 110, can be converted into a direct current varying from 90 to 140 volts, the variations being effected by suitable adjustments.

The rotary converter transforms alternating into direct current, the ratio of transformation being such as to give a direct-current voltage approximately one and four-tenths (1.4) times the alternating. If the alternating-current voltage is 100, the resulting direct-current voltage will be 140. Should a lower direct-current voltage be desired, the voltage of the alternating current can be reduced by the auto-transformers, which are part of the outfit. In order to start the rotary satisfactorily, a low voltage must be applied; this is also obtained by auto-transformers. The rotary converter delivers nominally 110 volts at practically constant e. m. f. The maximum current will be 60 amperes for about half an hour, when the current is gradually diminished to about 10 amperes at the end of about three hours. The rotary is adjustable by means of a field rheostat, so that the e. m. f. may be reduced from 110 volts to 95 volts. By changing to other loops on

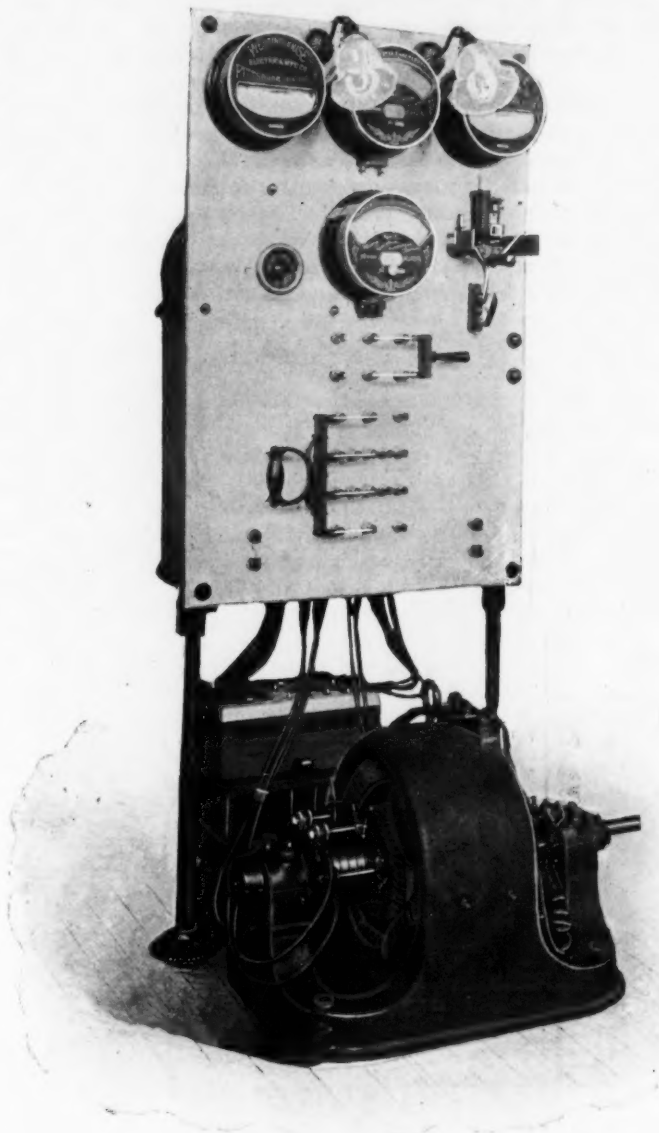


FIG. 1.—ROTARY CONVERTER AND SWITCHBOARD FOR CHARGING AUTOMOBILE STORAGE BATTERIES.

the lowering transformers, the e. m. f. delivered may be changed from 110 to 140 volts. When running at 140 volts, the e. m. f. may be lowered by means of a rheostat to 125 volts. The rotary is started by throwing a low voltage directly on the armature, and for this purpose suitable loops are provided from the auto-transformers. The rotary delivers direct current as a direct-current generator, but at several voltages varying from 110 to 140 volts. The e. m. f. is in each case capable of being reduced 15 volts by means of a field rheostat.

The two auto-transformers serve three purposes: (a) They reduce the line voltage to a pressure suitable for starting the rotary. (b) They furnish a voltage which, applied to the rotary, gives a direct-current voltage suitable for charging the storage batteries. (c) They introduce into the circuit self-induction of such an amount as permits a variation in the e. m. f. of the rotary by a simple adjustment of the rheostat.

The auto-transformers have a number of loops, as indicated at the bottom of Fig. 2, so that with either 100 or 110 volts on the primary, the rotary may deliver 105, 110, 115, 120, 130 or 140 volts. The coil is provided with a number of terminals in the form of binding posts, placed at the transformers, to which the wires to the switches may be connected. This is to secure certain fixed adjustments, and not to vary the voltage from the auto-transformers while the rotary is running.

The switchboard is provided with a double-throw switch for starting and running the rotary, with a double-throw switch for connecting the direct current to the battery, and also with a circuit breaker for opening the direct-current circuit in case the current is too great; in addition, there are ammeters for measuring the alternating current in each phase, an ammeter for measuring the direct current, and a direct-current voltmeter for measuring the voltage supplied to the battery. Fuses are placed in the alternating-current circuit for opening the circuit in case the current becomes too great. A rheostat enables the voltage applied to the battery to be varied over a small range.

The rotary stands in front of the board, as shown in the illustration, Fig. 1 with the auto-transformers at the back. In order to start the rotary, it is necessary to open the circuit breakers and all switches on the board, and turn the rheostat handle to the right as far as possible, thereby opening the field circuit, and then throw the large four-pole switch to the right. When the rotary has reached synchronism, the rheostat handle is turned to the left, thereby closing the field; and the field strength is adjusted until the alternating-current ammeter registers a minimum, and the large four-pole switch is then thrown quickly to the left, when, if all connections are right, the rotary will continue to run at a synchronous speed.

The rheostat should be adjusted again so that the current indicated by the alternating-current ammeter is a minimum. The direct-current voltage can then be raised or lowered from 5 to 10 volts by varying the rheostat, which will increase the alternating current. The e. m. f. when the alternating current is a minimum should be about 5 volts less than the maximum required for charging the battery. If the direct-current voltage is too high or too low, it is necessary to shut down by opening the main switch, and to make a change in the connections at the auto-transformers in order to supply the rotary with a different alternating-current voltage.

When the rotary is running and ready for operation, the circuit breaker should first be closed, and then the double-throw, direct-current switch should be closed in the direction indicated by the voltmeter. A small load of incandescent lamps should be placed between the binding posts from which the leads are to be taken to the battery. If the direct-current ammeter deflects in the wrong direction, the

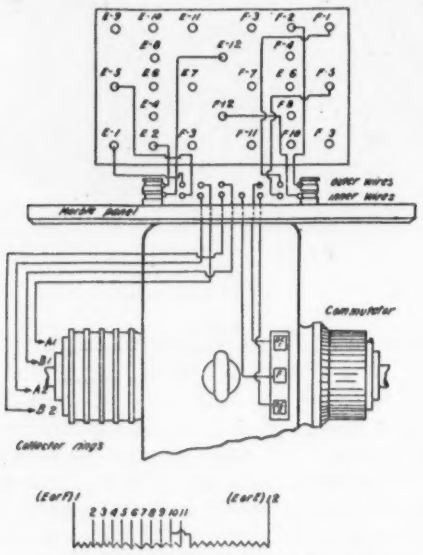


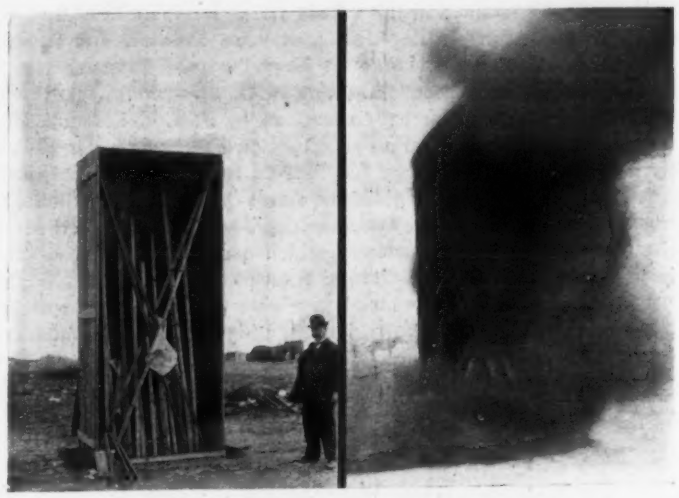
FIG. 2.—PLAN OF AUTO-TRANSFORMER TERMINAL BOARD.

leads to it should be reversed. All is then in readiness for applying current to the battery. When the battery is charged, the circuit breaker is to be opened by hand, the double-throw switch is to be opened together with the four-pole switch, and the rheostat should be moved to its extreme position.

As will be perceived by the illustrations, the outfit forms a complete whole, and all parts harmonize properly. By the arrangement adopted, the incoming wires are carried to the top of the switchboard, and the outgoing wires to the battery, from the side of the board, and the wires to the auto-transformers and the rotary, are taken from the bottom of the board in the form of flexible cables, all having proper lengths and being adjusted for the terminals to which they are to be connected.

Protection from Fire.

An interesting feature at the recent National Electric Light Convention in Chicago, was a practical demonstration of the usefulness



DEMONSTRATION OF THE USE OF "KILFYRE."

of "Kilfyre" as a fire extinguisher. The exhibition was given on the lake front, opposite the Auditorium, and was witnessed by the delegates and visitors to the convention, all of whom had been invited to attend. The structure erected for the purpose, which measured 14 x 6 x 4 ft., was coated with pine tar, and dry pine strips were placed inside; the whole structure was saturated with kerosene, and after ignition, from three to five gallons of oil were thrown on. The fire was extinguished in thirty seconds with a half-tube of "Kilfyre," and the experiment again repeated in the same length of time, consuming one tube.

Telephone Toll-Line Apparatus.

The accompanying illustrations show some of the telephone apparatus which has been designed especially for and adopted by the United States Telephone Company, of Cleveland, Ohio, which has as its chief aim the connecting up of the independent plants in Ohio and neighboring States. This company has found it not only advisable but absolutely necessary to install switching apparatus in the

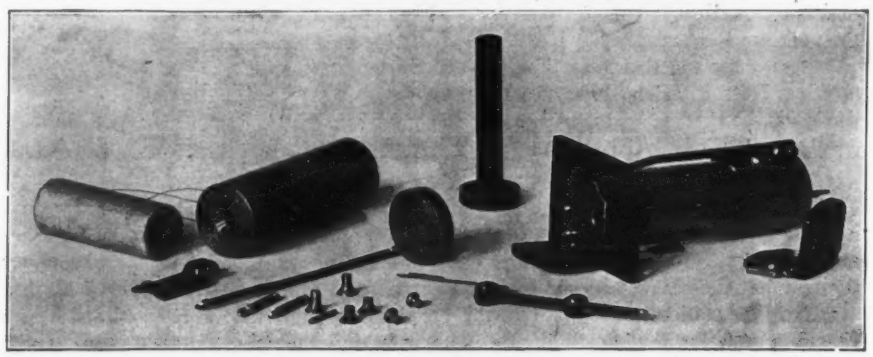


FIG. 1.—PARTS OF TOLL LINE BOARD.

different exchanges built on identically the same specifications, and has also found it necessary to insist that the exchanges with which it connects have their lines built according to a certain standard.

Among the special features worthy of notice are the tubular drops with soft Norway iron shells and close adjustment, this being one of the most sensitive drops ever manufactured. The company has also found it practical and advisable to have its switchboards so con-

nected that a "repeating coil" can be thrown into circuit at any time it is found that the metallic lines, when connected, are noisy, or when it is found necessary to connect grounded lines with metallic lines. Particular attention has been paid to these main features, with the result that a marked increase of efficiency is being obtained.

Figs. 2 and 3 show five and ten-line toll boards as installed in a number of small exchanges. This is distinctly a toll-line apparatus, and not in any way incidental to the operation of the local exchange. The apparatus described is that designed for the United States Company by the North Electric Company of Cleveland.

Electric Power in Charging Coke Ovens.

The Jones & Laughlin, one of the largest steel manufacturing concerns in the country, recently built a large number of coke ovens in Pittsburg which will be charged by means of electric cars. The company has purchased twelve equipments of railway motors from the Westinghouse Electric & Manufacturing Company, and a number of trolley lines have been built above the line of ovens. The cars which carry the coal are of special construction, and operated by a motorman. Each oven is filled by running over it a loaded car, the bottom of which can be dropped sufficiently to allow the fuel to pass into the oven. The cars will go from oven to oven in the work of charging. It is estimated that the saving of time by this method of charging will be enormous. The work was formerly done by mule power, but the electric method promises to be far superior.

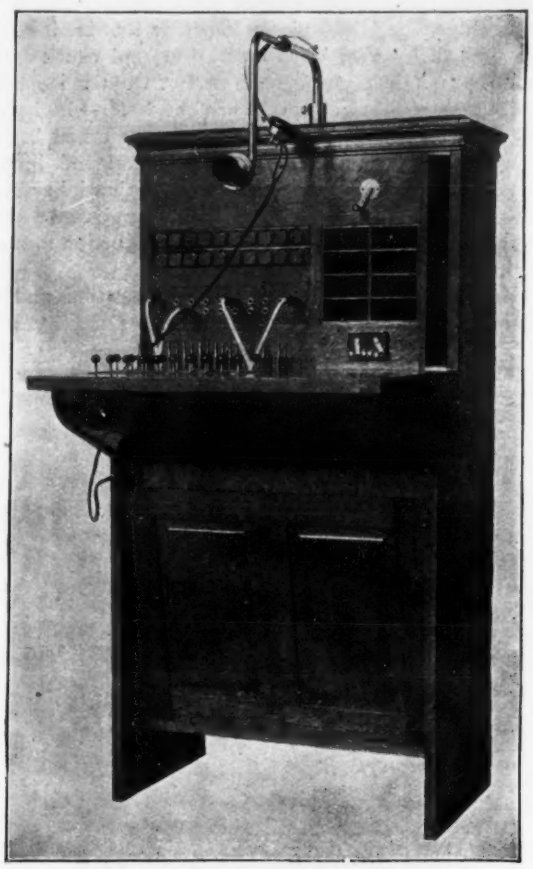


FIG. 3.—TEN-LINE TOLL BOARD.

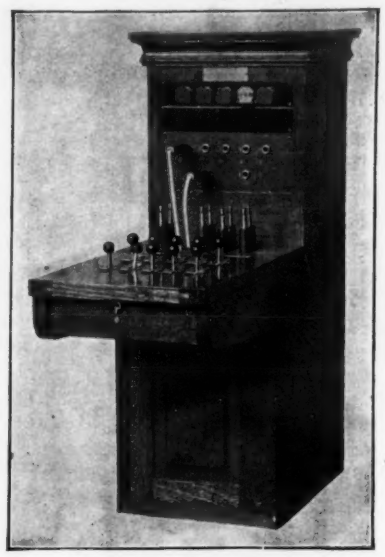


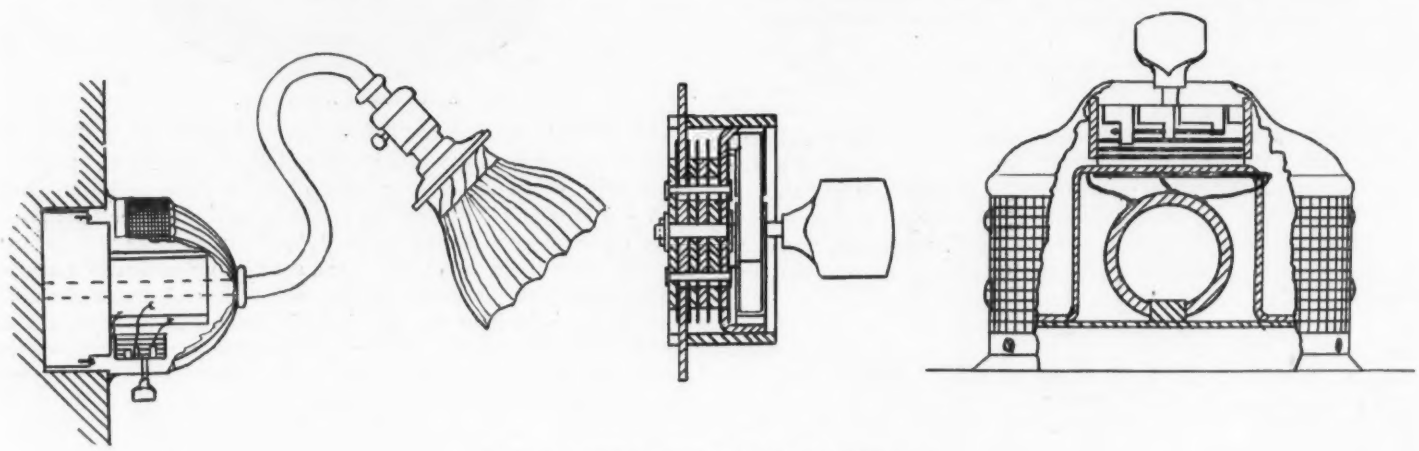
FIG. 2.—FIVE-LINE TOLL BOARD.

FIG. 1.—ELECTRIC LIGHT REGULATOR.

The Regulation of Single Electric Lights.

One of the great points of superiority of electric lighting has been in the readiness with which electric lamps can be controlled, all or any portion in a room being lighted or extinguished by merely turning a switch or pushing a button. But the single electric lamp has suffered in the comparison with the gas jet, in that it could not be turned up and down at will. It must be at full brilliancy or be wholly extinguished—a full blaze or no light whatever. This has been a serious disadvantage both in point of economy and as a matter of comfort and convenience, and has often prevented the adoption of electric light or caused many to continue the use of gas, also, in order that the long-accustomed and desirable low-turned light might still be enjoyed. This disadvantage has been especially felt in the sleeping rooms, halls and vestibules of private residences; in the corridors and bedrooms of hotels; in hospitals and in the staterooms of steamships. Heretofore all attempts to meet this great need have been directed to the lamp socket, but have not gone into very great use, because of their size or lack of general adaptability.

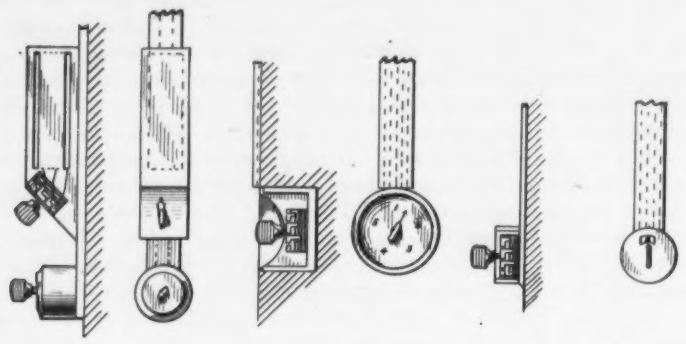
Among the new inventions indicated in the list of patents noticed in our last number, was one by H. E. Reeve, and issued to the Electric Regulator Company, 25 Cortlandt Street, New York, in which the resistance is located in the canopy or fixture, and is controlled by a novel switch. This dimmer, or regulator, is equally applicable to direct and alternating current, and while there is, of course, some loss, as in all rheostats, there is a current saving of from one-third to three-fourths, as shown in Fig, 8, according to the degree to which the light is turned down. The device is practically indestructible, the resistance being in an enameled cast-iron tube, and the switch constructed of



FIGS. 2, 3 AND 4.—ELECTRIC LIGHT REGULATOR.

alternate layers of metal and mica so riveted together as to be apparently incapable of derangement. This switch is made in two forms, either with sliding contacts to be used as a regulator only, with a key, or as a snap switch.

Fig. 1 shows the device in the canopy of a combination fixture, the



FIGS. 5, 6 AND 7.

resistance tube being slipped over the insulating joint. Fig. 2 shows it adapted to a purely electric bracket with an outlet box. Fig. 3 shows the switch construction, with alternate layers of metal and mica, extended arms of the metal plates being turned up like a series of up-turned fingers, forming a continuous row of contacts arranged in a circular path, ready for contact with a contact spring revolved by a central key shaft.

Fig. 4 shows a resistance tube and switch used separately from the lighting fixture, and connected by wiring with the lamp at a distance.

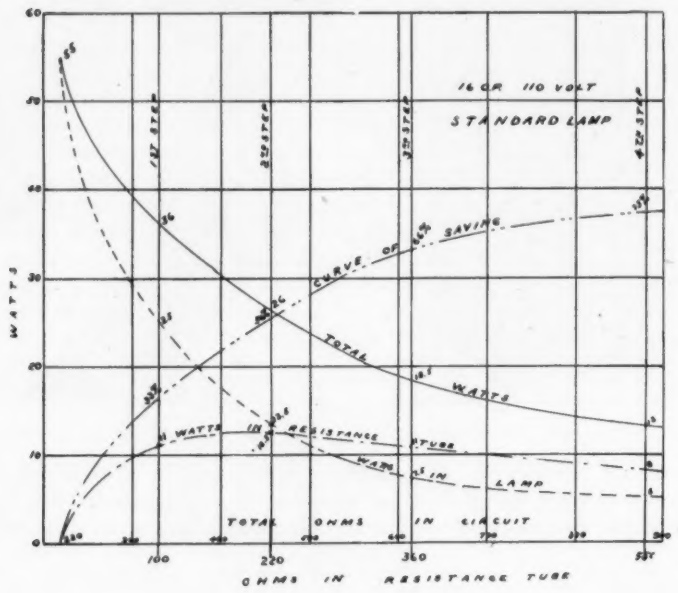


FIG. 8.

This may be either a snap switch used alone, or as in Fig. 5, a sliding switch turning the light up and down, inserted in one leg of a line controlled by an ordinary snap switch, as in a stateroom or corridor. Figs. 6 and 7 show the switch used alone, as flush or surface switch, to be connected with the different steps of a rheostat, with a pointer or other means to indicate gradations of electric current for any purpose.

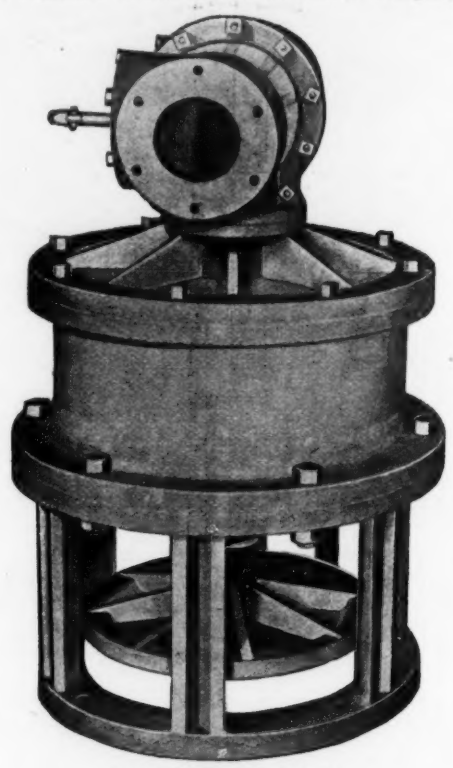
Relief Valves in Water Power Plants.

One of the most difficult problems connected with delivering water through a long pipe is the prevention of what is commonly called water hammer. Water is heavy and practically incompressible. It is, of course, impossible to arrest the motion of a heavy incompressible body suddenly without exerting considerable pressure against it. The amount of pressure required to stop a body in a given time, when moving at a given velocity, is just the same as the pressure required to give the same body the same velocity in the same time. Moreover, for a given momentum, the shorter the time in which the velocity of the body is arrested, the greater will become the force necessary to stop it. It is for this reason that water may be cut off by closing a valve gradually without increasing the pressure much; but if the valve is closed quickly, the pressure becomes very great.

In order to govern the speed of a water wheel accurately when the load varies rapidly, it is necessary to open and close the gates with great promptness so as to vary the amount of water which flows through the wheel to correspond to the load. If the water wheel is located at the end of a feed pipe the velocity of the water therein contained must be varied to correspond to the variations in load; and every time load decreases and the water-wheel gates close more or less the water pressure will increase for the reasons above stated. It is thus apparent that the water-hammer effect becomes a disturbing element in speed regulation in proportion as it is a large per cent of the working pressuse at the water wheels.

Where a water-wheel feed pipe is more or less inclined from the vertical, a limit of length is soon reached beyond which speed regulation cannot be obtained unless some sort of valve is installed at the water-wheel case, which will open when the water-wheel gates close and allow the water to escape until the pressure comes back to normal. Many kinds of relief valves have been designed, in which the water pressure is opposed by springs or weights, but it has been found in practice that if such valves are set to open on a small increase of pressure, the pressure will run up greatly in proportion to the amount of water the valve is called upon to vent.

The valve shown in the accompanying illustration, and which is made by the Lombard Water Wheel Governor Company, of Boston,



LOMBARD RELIEF VALVE.

is claimed to be free from all the above objections. In it the water pressure against the valve disk is opposed by the static water pressure at the point where the valve is attached to the flume or water-wheel case, and as long as the working pressure does not exceed the static pressure, the valve will remain closed; but if the flume pressure at any moment exceeds the normal pressure even by a fraction of a pound to the square inch, the valve will instantly open and vent water until the pressure is back to normal. It will open with equal promptness whether it is called upon to vent a very small amount of water or the full amount which can flow through it when wide open. It has adjustments so that it can be made to open at any increase of pressure which may be desired. Its interior surfaces and curves are carefully designed so that it has a very large coefficient of discharge.

The cut shows the valve partly open. The upper flange is bolted directly to a flanged branch from the flume or wheel case. The valve may be installed vertically, as shown, or horizontally. It is stated that this valve, installed under the most difficult conditions, has enabled good speed regulation to be obtained in plants which were utterly ungovernable without it.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—Money on call closed at 1¾@2 per cent. Time money is quoted at 3 per cent for four months 3½ per cent for six months, and4 per cent for eight months. Commercial paper is quoted at 3½@3¾ per cent for prime single names, bills receivable; other names, 4@4½ per cent. The weekly statement of averages of the Associated Banks shows a gain in lawful money of over $4,000,000, the greater part of which was in specie. The loans, owing to heavy borrowings in connection with syndicate operations at the close of the week before last show an increase of $7,347,000. The net result brings the surplus up to over $20,000,000, which is a fairly good showing for this season of the year. In the stock market, the speculative dealings were restricted last week, and the public did not appear to take any real interest in the market. The railroad list was generally strong and steady; the traction stocks were active and irregular, more or less uncertainty attending the position of Brooklyn Rapid Transit. New York gas stocks became again firm on the announcement that the Consolidated Gas Company had purchased the majority interest in the Standard Gas Light Company. The market for outside securities showed little improvement, but there was a stronger tone on the last two days of the week. To some extent the improvement of the market was merely a reflection of the better conditions which prevailed in the inside market during the latter part of the week, but it also was due to a large extent to the fact that many outside stocks have of late been liquidated to such an extent that they have reached a point where further declines could hardly occur except as a result of bad news, which thus far has failed to develop to any extent. This practically has seemed the condition of the market for several weeks past, but actual evidence of it was only furnished at the close of last week, when an upward turn occurred in several prominent issues. As compared with the final prices of the week before, Stock Exchange quotations are generally higher. Brooklyn Rapid Transit closed at 72½, a net gain of 1¼ points, the sales being 36,788 shares; General Electric closed at 136, a net gain of 2⅜; Metropolitan Street Railway closed with a net gain of 2½ points, the final quotation being 157½; Third Avenue closed at 113, a net loss of 1¼, and Western Union at 79⅞, a net loss of ⅛ point. The following are the closing quotations of outside securities: Electric Boat, 17; do. pfd., 35; Elec. Vehicle, 25; do. pfd., 65; Gen. Carriage, 8; Ill. Elec. Vehicle Transp., 1⅜; New England Elec. Transp., 4; New York Elec. Vehicle Transp., 8⅛; Telegraph, Telephone & Cable of America, 4½; Commercial Cable, 160. In Boston, Bell Telephone closed at 304; Erie Telephone, 101; Westinghouse Elec., 44½.

NEW ENGLAND ELECTRIC VEHICLE.—A Boston despatch states that the New England Electric Vehicle & Transportation Company, while not yet in a position to demonstrate its true earning capacity, is making handsome gross earnings per vehicle. Its operating expenses per vehicle are extraordinarily high owing to the fact that it requires practically the same amount of station apparatus for 50 or 60 vehicles as for many times that number. Then again it is now obliged to do its charging and renewing of batteries by hand, whereas it is proposed to do all this by machinery at a great saving in expenses. It is not expected that the company will be in a position to give a good account of itself until autumn, for by that time it will have between 300 and 400 vehicles in commission, including 100 cabs, 100 delivery wagons and 100 open vehicles. It now has in service 60 cabs, 15 delivery wagons and 100 open and light vehicles, the latter being in Newport, R. I. The company is selling vehicles outright, but is not pushing their sale owing to the delay in getting the vehicles. The New England Company is opening stations for the renewal and charging of batteries at various points in the city and outlying districts, namely, at Lynn, Salem, Waltham, Lexington and Cambridge. It will have thirteen of these stations. For some time the company has not been able to supply the demands for its cabs.

THE SOUTHERN OHIO TRACTION COMPANY has filed mortgages in Hamilton, Butler and Montgomery Counties, Ohio, to secure a bond issue of $2,000,000, given by the company to the Cleveland Trust Company, Cleveland, as trustee. The bonds were issued for the purpose of redeeming bonds amounting to $1,300,000, held against the companies which it succeeded; also to pay for improvements about to be made. The bonds to be redeemed are $400,000 issued by the Cincinnati & Hamilton Street Railway Company; $250,000 by the Dayton Traction Company, and $650,000 by the Cincinnati & Miami Valley Traction Company. The bonds are to be of the denomination of $1,000 each, with interest at the rate of 5 per cent, payable May 1, 1920. The mortgages cover all the property, real and personal.

ERIE TELEPHONE BONDS.—An announcement was made a short time ago of the sale of $2,000,000 5 per cent collateral trust bonds of the Erie Telegraph & Telephone Company to New York bankers. It appears now that the purchasers were Wilson & Stephens, who, with Toland Bros. & Co. and Townsend, Whalen & Co., of Philadelphia, will shortly make a public offering at 102½ and interest. It is said that nearly half of the above amount has already been privately sold to Philadelphia, Boston and New York interests.

LONG ISLAND PLANTS SOLD.—It is officially announced from Philadelphia that the Electric Company of America has sold both of its Long Island plants to the New York syndicate. The price is stated as over $1,000,000, payable about the middle of June. The purchasers are supposed to be identified with the Consolidated Gas interests.

GENERAL ELECTRIC DIVIDEND.—The directors of the General Electric Company have declared the regular quarterly dividend of 1½ per cent on the common stock and a regular semi-annual dividend of 3½ per cent on the preferred stock. The common dividend is payable July 15 and the preferred July 31.

MAY CORPORATIONS.—New corporations of $1,000,000 capital or more chartered in May in New Jersey and West Virginia, New York and Delaware, and miscellaneous States, reached a total of $261,600,000. The American Bridge Company is the largest on the list.

CHICAGO CITY RAILWAY NEW STOCK.—The Chicago City Railway Company will issue $500,000 of new stock on Oct. 1. As its capital is $13,000,000, each holder of 26 shares of the present stock will be entitled to one share of the new issue at par.

PAN-AMERICAN EXPOSITION BONDS.—The capital stock of the Pan-American Exposition Company is to be supplemented by the issue of $2,500,000 in bonds, increasing the available capital to $5,000,000.

Commercial Intelligence.

THE WEEK IN TRADE.—The quieting down of industrial operations does not seem to have had much effect on railroad earnings, as these continue good. The fact seems to be that the volume of business offered the transportation interests of the country continues considerably in excess of a year ago. The hand-to-mouth domestic demand for iron and steel continues, Bradstreet's reports, but the number of small orders received is taken to indicate that consumers are practically bare of stocks, and any general shut-down for a month's time, such as is proposed, might lead to a scramble for supplies. Export business continues good, though limited by the scarcity of freight room, southern pig iron and steel rails noting most inquiry. The situation in the pipe market is no better, and plates are also weaker. Concessions of fractions of a dollar are apparently easily obtained for pig iron, but throughout the trade the feeling is rather more cheerful, the feeling being that lower prices will, on the one hand, encourage consumptive demand, and, on the other, tend to restrict production by less economical plants. The settlement of the wage situation this year might also be a possible source of restriction of production. Copper is lower on the week, notwithstanding the practical stoppage of production by the heaviest producer, owing to a mine fire. Tin is weaker and lead lacks strength. Gross earnings of 70 roads for the third week in May aggregate $8.811,574, a gain of 10 per cent over last year. For the month of April the gross earnings of 60 roads agregate $56.898,773 and net receipts $16,382,068, gains of respectively 13.7 and 14.1 per cent over April last year. The market for copper remains quiet at 16½@16¾c. At the moment, buyers and sellers seem indifferent as to the course of prices. Copper is in good position and large quantities are going into consumption and stocks must be replenished soon. The future course of prices depends a good deal upon the results of the Calumet & Hecla fire. The visible supply of copper in London on June 1 was 29.204 tons, an increase of 2160 tons since May 15. Supplies for month 25.240 tons, of which 13,431 were from America; from Chili, 2600. Deliveries, 22,836 tons.

As to the iron market, the *Iron Age* says the best that can be said for it at present is that a feeling of hopefulness is developing. The demand seems a little better in some branches of the trade and buyers are disposed to place orders more freely. This is particularly true of the West. Prices are irregular. Wire rods are quoted at mills in the Central West at $38 to $47.50. Bradstreet's reports the business failures for the week as numbering 135, compared with 167 last week, 129 in this week a year ago, 178 in 1898, 192 in 1897 and 236 in 1896.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material and kindred lines from the port of New York for the week ended June 2: Argentine Republic—31 cases electrical material, $1,841. Antwerp—6 cases electrical material, $1,486. Amsterdam—2 cases electrical material, $59. Brussels—2 cases electrical material, $450. Barcelona—21 packages electrical material, $4,475. British West Indies—14 packages electrical material, $278. Bristol—124 packages electrical machinery, $5,820. Breslau—1 case electrical material, $16. British possessions in Africa—18 cases electrical material, $1,313. Berlin—1 case electrical material, $5. British Guiana—22 packages electrical material, $1,015. Brazil—24 packages electrical material, $1,092; 1 case electrical machinery, $80. Cuba—23 boxes electrical machinery, $15,100. Central America—29 cases electrical material, $912. Genoa—5 cases electrical material, $2,119. Glasgow—29 cases electrical material, $6,025. Gyon—10 cases electrical material, $288. Hamburg—135 packages electrical material, $18,141; 22 packages electrical machinery, $3,045. Havre—188 packages electrical material, $10,869; 56 packages electrical machinery, $4,983. Hayti—2 cases electrical material, $35. Lisbon—2 cases electrical material, $396. London—199 cases electrical machinery, $40,291; 106 packages electrical material, $4,205. Liverpool—29 packages electrical machinery, $5,000; 16 cases electrical material, $273. Mexico—47 packages electrical material, $1,349. Margate—3 cases electrical machinery, $5,367. Nova Scotia—1 package electrical material, $52. Naples—26 cases electrical machinery, $7,400. Newfoundland—50 packages electrical material, $327. Puerto Rico—2 packages electrical material, $22. Peru—8 packages electrical material, $284. Southampton—4 cases electrical machinery, $44. Vienna—2 cases electrical material, $21. Zürich—2 cases electrical material, $25.

EXPORTS TO CUBA AND OUR NEW POSSESSIONS.—Exports from the United States to Cuba, Puerto Rico and the Hawaiian, Philippine and Samoan Islands will reach $45,000,000 in the fiscal year which ends with the present month, and will be more than three times as much as in 1896, and more than twice as much as in any year of our commerce with those islands, except in the years 1892, 1893 and 1894, when reciprocity greatly increased our exports to Cuba and Puerto Rico. To Cuba, the total for the fiscal year seems likely to be fully $25,000,000, against $7,530,000 in the fiscal year 1896 and $24,157,000 in the great reciprocity year 1893, when exports to that island were more than double those of five years earlier. To Puerto Rico, the exports of the year will be in round terms $2,600,000, against an average of $2,750,000 in the reciprocity years 1892, 1893 and 1894, when exports to that island were double those of earlier years. To the Hawaiian Islands, the total for the year will be about $15,000,000, or five times as much as in 1893, nearly four times as much as in 1896, and more than double the total for 1898. To the Philippines, the total for 1900 will be about $2,500,000, or more than in the entire fifteen years since 1885, the date at which the first record of our exports to the Philippines was made by the Treasury Bureau of Statistics. To the Samoan Islands, the exports of the year will be about $125,000, or nearly as much as in all the years since 1896, at which date the official records of our exports to those islands began.

EXPORTS TO ASIA AND OCEANICA in the fiscal year which ends with the month of June, will for the first time in our history exceed $100,000,000. In no part of the world has our export trade grown with such amazing rapidity, with the single exception of Africa. In 1893 our total exports to all Asia and Oceanica amounted to only $27,421,831, so that in the fiscal year now about to end they will be about four times as great as those of eight years earlier. The growth in exports is chiefly in cotton, breadstuffs, provisions and manufactures.

NEW CAR WHEEL PLANT.—A Pittsburg despatch states that one of the largest and most modern car wheel plants in the country will be built within the next 60 days near Homestead. The Keystone Car Wheel Company has been formed for the purpose with a capital of $200,000, and plans have been prepared for a plant with a primary capacity of from 300 to 350 car wheels a day, but with provisions for an eventual capacity of 600 wheels daily. The company has purchased a site of 10 acres for $60,000, and material is on the ground. The organizers and directors are Charles V. Slocum, formerly treasurer and manager of the Pennsylvania Car Wheel Company; William L. Elkins, assistant treasurer of the Consolidated Traction Company, Pittsburg; William W. Lobdell, president of the Lobdell Car Wheel Company, of Wilmington; Louis B. Whitney, formerly of A. Whitney & Sons, of Philadelphia, and Charles A. Otis, Jr., of Cleveland. John G. Holmes and Nathaniel Holmes, the Pittsburg bankers, will also be interested.

ELECTRICAL MACHINERY MARKET.—In general the condition of the market for electrical apparatus is satisfactory. The manufacturers in general seem to have enough orders in hand to keep their entire facilities engaged in turning out work. The larger companies seem to be getting all the work they want, while some of the smaller ones, not being quite so successful, show a tendency to make low bids in order to get work. Down town in New York preparations are under way for the erection of several new business buildings, all of which will require electrical equipment. Among these future buildings may be mentioned the new Custom House, for which excavations are now being made. The Bullock Electric Manufacturing Company is installing an electric power equipment in the Fall River Engine Company's new shipbuilding plant at Weymouth, Mass. The installation includes a 100-kw generator and forty motors. As many more motors will be required later on.

RAPID TRANSIT CONTRACTS AWARDED.—The contract for furnishing the steel and iron for the New York Rapid Transit Subway has been finally executed by the American Bridge Company. The American Bridge Company, with $70,000,000 capital, was organized after the contract was first awarded to the Carnegie Company. The contract calls for 21,729 tons of steel beam, 20,147 tons of riveted steel, 23,168 tons of steel viaduct, 245,514 feet of rails for tracks in the subway and 59,666 feet of rails for tracks on the viaduct. The contract price is, approximately, $6,000,000. It was announced on April 16 that the contract for furnishing structural steel and iron for the subway had been awarded to the Carnegie Steel Company. The American Bridge Company is the result of the combination of 25 bridge concerns, of which the Carnegie Company's Keystone Bridge Company is one.

NATIONAL TUBE.—A Pittsburg despatch states that all the branch houses of the National Tube Company in the country, except the four located in New York, Chicago, San Francisco and Pittsburg, will be closed on June 1. In future all shipments of the products of the company will be made from the various works in different parts of the country. The new order will do away with about 800 employees, and result in a saving for the combine of not less than $1,000,000 a year.

STANDARD UNDERGROUND'S PACIFIC COAST PLANT.—It is reported that the Standard Underground Cable Company, of Pittsburg, which established a branch factory in Oakland, last fall, has decided to enlarge its business in that city. Another building is to be constructed, in which machinery will be installed for making all kinds of electrical cables, telegraph and telephone wires and overhead trolley wires. The wires are drawn in the main factory at Pittsburg.

NEW STREET CAR FACTORY.—The local Board of Trade of Bucyrus, Ohio, has under consideration a proposition made by C. Roehr & Sons, manufacturers of the Duplex street cars, for the erection in Bucyrus of a large plant for the manufacture of street cars. The proposition contemplates the organization of a new stock company with a capital of $200,000; estimated cost of shops and machinery to be $75,000.

BOSTON ELEVATED RAILWAY.—Contracts have been awarded for the electrical equipment of the Boston Elevated Railway, as follows: Motors, to the Westinghouse Company; Controllers, to the Sprague Company. Some time ago the order for generators was placed with the Westinghouse and General Electric Companies, each to furnish a 3000-kw machine.

ELECTRIC RAILWAY EQUIPMENT FOR RUSSIA.—There will soon be a call for track material for an electric railway in Jaroslaw, Russia. A company has recently been formed in Silessin, Belgium, with a capital of $500,000, to build a tramway in Jaroslaw. The company is organized under the auspices of the Compagnie Generale de Traction et de l'Electricite.

GAS ENGINES IN ITALY.—Otto gas engines are to be manufactured in Italy on an extensive scale by La Societa Langen & Wolf, a company just formed in Milan, with a capital of $2,400,000. Considerable machinery, tools and factory supplies will, no doubt, be required in the enterprise, for which American manufacturers can compete advantageously.

McINTOSH, SEYMOUR & CO., Of Auburn, N. Y., have secured an order for a 1200-hp. engine to be utilized in the power house of the City of Mexico Tramways Company Limited, which concern, as already mentioned in these columns, is about to considerably extend its operations. The order for boilers will, it is said, be given out next week.

EXPORTS OF ELECTRICAL APPARATUS TO FRANCE.—It is reported that the average weekly shipments of electricial material to France continues to be from $20,000 to $30,000.

General News.

THE TELEPHONE.

CANYON CITY, ORE., will soon have a telephone exchange in operation.

GALESVILLE, WIS.—The Wisconsin Telephone Company has asked for a franchise in this city.

PORTAGE, WIS.—The Portage Telephone Company will build a long-distance line from Portage to Merrimac.

OMRO, WIS.—The application of J. Hoyt, of Joplin, Mo., for a franchise to put in an electric lighting plant was passed.

COLUMBUS, OHIO.—The Covington Home Telephone Company, of Covington, has been incorporated, with a capital stock of $10,000.

ROCHESTER, N. Y.—The New Home Telephone Company, of Rochester, starts off with 2200 subscribers. The Bell Company has 2500.

CINCINNATI, OHIO.—All the branch exchanges of the Cincinnati Telephone Company are now equipped with common battery switchboards..

AKRON, OHIO.—The Akron People's Telephone Company has been incorporated. Capital, $200,000. Incorporators: W. Christy, A. B. Conklin.

THE ERIE TELEPHONE SYSTEM made a net gain of 2939 subscribers in May. Total number connected May 31, 123,711. Number waiting connection, 5909.

BUENOS AIRES.—Messrs. Laborde & Company have signed the contract for the construction of the telephone line between Buenos Aires and Rosario, Argentina.

THE PACIFIC COAST telephone system made a net gain of 1997 subscribers in May; total number connected May 31 was 75,193, of which 18,909 are in San Francisco.

SPRINGFIELD, MASS.—The Hampden Automatic Telephone Company has purchased a valuable site here and will erect an office building, reserving for its own use the upper stories.

MT. BLANCHARD, OHIO.—Mr. Oscar Wise has secured a franchise to install a local exchange with a toll line to Arlington to connect with the United States Telephone Company.

OMRO, WIS.—The Village Council has refused to grant a franchise to the Wisconsin Telephone Company to put in an exchange here. The Wolf River Company has a large exchange here.

TOMAHAWK, WIS.—The telephone line between this city and Brannan, Price County, put in by the Electric Water & Telephone Company of this place has been finished and is now in operation.

TOLEDO, OHIO.—A new independent telephone company is preparing to ask for a franchise in Toledo. It is stated that the rates will be $40 per year to business houses and $30 per year to residences.

SPRINGERTON, ILL.—The Springerton & Millshoals Telephone Company has been incorporated. Capital, $2,500. Incorporators: J. W. Springer, J. N. Upton, L. W. Hendershott, all of Springerton.

RAVENNA, OHIO.—The new exchange of the Home Telephone Company will be placed in operation in a few days. The Butler-Taylor Company, of Ravenna, is furnishing nearly all of the equipment.

SAN FRANCISCO, CAL.—The San Francisco Board of Supervisors has passed an order limiting the number of telephone subscribers on a party line to five. Many ten-party lines are in use in that city.

TIPTON, IA.—The Tipton Telephone Company, of Tipton, Cedar County, has been incorporated, with a capital of $10,000. The directors of the company are E. R. Willix, W. A. Smyth and John T. Moffit.

FINDLAY, OHIO.—The Central Union Telephone Company is rebuilding its exchange at an expense of $40,000. Party lines are to be discontinued and lower rates given. The work will be completed within 60 days.

WILTON, N. H.—The Wilton Telephone Company has filed articles of incorporation. Capital stock, $2,000. The incorporators are George E. Bales, C. E. Higgins, W. I. Durgin, Joshua F. Frye and H. L. Emerson.

NEW PRAGUE, MINN.—The New Prague Telephone Company has been incorporated. Capital, $10,000. Incorporators: S. A. Vopatak, J. F. Barta, M. Rybak, all of New Prague; A. J. Edgerton, attorney, New Prague.

PORTLAND, IND.—The Geneva Telephone Company, of Geneva, has been organized, and will be sub-licensed by the Central Union Telephone Company. The officers are: President, A. G. Briggs; H. M. Aspy, secretary and general manager.

KINGSTON, TENN.—The Roane County Telephone Company has been incorporated here. Capital, $2,500. Incorporators: J. A. Erwin, J. E. George, T. L. Peterman, T. A. Wright, G. M. Peterman, T. A. Wright, G. W. Cooper, all of Kingston.

MARSHALL, MO.—The Saline County Telephone Company has extended its line from Marshall to Miami. In a short while its toll lines will reach all towns in Central Missouri. The company was organized last September and now has in use 338 telephones.

SAN FRANCISCO, CAL.—The Inland Telephone & Telegraph Company is ready to begin work on the new 45-mile line from Coulee City to Waterville, Douglass County, Wash. The same company is now constructing a line from Elgin, Ore., to Joseph.

MOSINEE, WIS.—Promoters of the county telephone system are testing public sentiment in regard to the matter and report a favorable impression throughout the county. The capital will be furnished by the county residents in shares at $25 each. The entire cost of building the system is estimated at $70,000.

ROCHESTER, N. Y.—The stockholders of the Rochester District Telephone Company held their annual meeting recently. Officers and directors elected are as follows: President, S. B. Gifford; vice-president, C. A. Tinker; secretary and treasurer, G. D. Butler; directors, J. C. Kalbfleisch and Erickson Perkins.

FORT WAYNE, IND.—The council has ordered overhead wires to be put underground in the central district. The action is directed at the Bell Telephone Company, which has an overhead franchise in that territory and maintains its wires on unsightly poles. Other companies have already put their wires underground.

FALL RIVER, MASS.—The Fall River Automatic Telephone Company is out with a circular announcing that citizens who are subscribers to the new system can take stock not exceeding 10 shares, $500. There are already 500 telephones contracted for, and as soon as the stock matter is closed, work will be commenced on the lines.

CLEVELAND, OHIO.—The Cleveland Telephone Company has held several conferences with its striking electrical workers, but no agreement can be reached. The company has offered to give nine hours' pay for ten hours' work, but the men are holding out for an eight-hour day. The company has announced that new men will be imported from other parts of the Erie system.

PITTSBURG, PA.—The West Penn Long Distance Telephone Company has been organized by Pittsburg and Baltimore capitalists. All the men interested are also connected with the Pittsburg & Allegheny Telephone Company, the rival of the local Bell Telephone Company, and it is understood that this long-distance branch will be an extension of the Pittsburg & Allegheny Company.

ROCHESTER, N. Y.—The Bell Telephone Company was recently notified by City Engineer Fisher, at the instance of the board of estimate and apportionment, that at the end of the current 30 days the existing contract for the use of Bell telephones by the city would be terminated. The city now uses 52 instruments of the Bell Company, at prices varying from $84 to $110 each.

McKEESPORT, PA.—The Councils of the city of McKeesport, Pa., have passed an ordinance granting the Central District & Printing Telegraph Company, of Pittsburg, the right to construct conduits through the streets for the purpose of placing the wires underground. The ordinance makes the rate for telephone service $2.50 a month for business houses and $1.50 for residences.

DULUTH, MINN.—Judge Lochren in the United States Court granted a temporary injunction in the case of the Duluth Telephone Company against the city of Duluth. The suit is brought to enjoin the city from removing the poles and wires of the old company whose franchise ran out last year. The city made a contract with the Zenith Telephone Company, and is seeking to oust the old company.

GUTHRIE, OKLA.—The Jefferson Telephone Company has been chartered with $10,000 capital stock and for the purpose of building and operating a telephone system throughout Oklahoma and Indian Territories. The principal place of business is at Perry. Directors: D. M. McKinstry, E. D. Nims, John M. Noble, E. E. Westervelt, Perry; F. D. Hummer, Washington, D. C.; W. E. Caldwell, Louisville, Ky.

SAN FRANCISCO, CAL.—James L. Crittenden, the San Francisco attorney, has returned from New York City. He states that the People's Mutual Telephone Company, organized in San Francisco, has contracted for $300,000 worth of material. It is the purpose to put in an improved Bell telephone system, and the rates will be 60 per cent lower than those now charged in San Francisco. Work will be commenced before July 1.

SAN FRANCISCO, CAL.—The city of San Francisco has, through Tax Collector Scott, sued the Pacific Telephone & Telegraph Company for $196,000 claimed to be due on account of nickel-in-the-slot telephones maintained in the city. An ordinance was passed Oct. 8, 1898, requiring such license to be paid. There is also demanded of the company $5,000 for licenses on other telephones and for carrying on the company's business.

BOSTON, MASS.—The Massachusetts Telephone & Telegraph and Boston & New York Telephone & Telegraph companies will remove their executive offices to the fourth floor of their new central telephone building, corner Pearl and Franklin streets, on July 1. The offices now used by these companies at 15 Congress Street will then be occupied by the officials of the Erie Telegraph & Telephone Company. The Massachusetts Telephone & Telegraph Company has now secured franchises in 59 Massachusetts cities and towns.

SAN FRANCISCO, CAL.—The People's Mutual Telephone Company, of San Francisco, which last year took preliminary steps for the installation of an independent telephone system, proposes to begin construction work before July 1. Manager J. L. Crittenden recently returned from New York, where he made arrangements looking toward the construction of a system having a capacity of serving 20,000 subscribers. A trust deed has been recorded in San Francisco by the Union Trust Company, as security for the People's Mutual Telephone Company's bonds in the sum of $500,000.

AUSTIN, TEX.—A score or more of independent telephone companies have been organized in Texas during the past two months. They are confined principally to smaller towns. It is said that most of these new companies are identified closely with the Lone Star Telephone & Telegraph Company, which was incorporated in Texas a few months ago with a capital stock of $500,000 for the purpose of building and operating a long-distance system and local telephone exchanges in all the principal cities of the State. The independent companies in all the smaller places will connect their lines with the long-distance system.

PITTSBURG, PA.—The West Penn Long Distance Telephone Company, recently organized, and for which a charter will be applied for on June 14, at Harrisburg, will be a branch of the Pittsburg & Allegheny Long Distance Telephone Company. It will construct and operate telephones in the counties of Erie, Crawford, Mercer, Lawrence, Beaver, Butler, Venango, Armstrong, Westmoreland, Fayette, Washington, Green, Somerset, Clarion, Franklin, Adams, Cambria, Bedford, Indiana, Fulton, Franklin, Adams, York and Cumberland. The capital stock of the new company will be nominal and later will be increased to meet the demands of the concern.

INDIANAPOLIS, IND.—The members of the advisory committee of the Independent Telephone Association, composed of James M. Thomas, president, Chillicothe, Ohio; S. P. Sherin, secretary, Indianapolis, and E. B. Fisher, Grand

Rapids; H. D. Critchfield, Columbus, and Hugh Daugherty, Bluffton, met at the Grand Hotel on May 28, to complete arrangements for the annual convention of the association at Cleveland, June 12, 13 and 14. The convention will be attended by a thousand delegates and manufacturers of telephone apparatus. At the association meeting Mr. Daugherty will read a paper on "Independent Telephone Investments." At the banquet Mr. Sherin will make an address on "Patent Rights and People's Rights."

CHICAGO, ILL.—It is announced that the negotiations of the promoters of the Illinois Telephone & Telegraph Company have been broken off, and that a great conduit scheme has been taken up by the capitalists interested. The Philadelphia syndicate refused to purchase the Illinois Company's franchise at terms satisfactory to the latter. An agent of the Independent Telephone Company has been in Chicago for several days looking over the plant of the local company, but the officials say he wanted the property at bargain-counter figures, and he returned to Philadelphia without investing in the new telephone enterprise. The original promoters of the Illinois Company will probably abandon the telephone scheme and go into the conduit business.

ELECTRIC LIGHT AND POWER.

SALEM, ORE., recently granted F. R. Anson a franchise for operating an electric light and power and steam-heating plant.

THORNTOWN, IND.—At a recent election in this place, municipal ownership of the electric light plant was favorably voted on.

CUERO, TEX.—The recent flood in the Guadalupe River, in Texas, caused considerable damage to the electric light plant at Cuero, Tex.

SMITH'S FALLS, ONT.—The Smith's Falls Electric Light Company will build an addition to its power house and also will install new apparatus.

HAMMOND, IND.—The municipal electric light plant of West Hammond was totally destroyed by fire on May 28. The loss is estimated at $10,000.

SPRINGFIELD, ILL.—The Consolidated Water & Light Company, Chicago, has been incorporated. Capital, $100,000. Incorporators: J. H. Brown, B. O. Mayer, M. J. Cook, all of Chicago.

MORRISBURG, ONT.—A by-law authorizing the corporation of the town of Morrisburg, Ont., to acquire water privileges and construct an electric light and power plant has been voted upon and adopted by the ratepayers.

RICHMOND, IND.—The City Council committee on light has reported in favor of an electric light plant being erected at once by the city, to do commercial lighting and to light the city as soon as the present contract expires.

ISLIP, L. I.—The Town Board of Islip has granted a franchise for 50 years to the Sayville Electric Light Company, and also granted the application for a lighting district in the village of Sayville.

HOUSTON, TEX.—The new municipal electric light plant of Houston, Tex., will have a capacity of 500 arc lights and 600 incandescent lights. The Western Electric Company, of Chicago, has the contract for its construction.

CARLINVILLE, ILL.—The municipal authorities are considering the building of an electric plant of their own to light the city. It will cost from $10,000 to $20,000. Mr. Charles Woodward, of the Assembly, was appointed a committee to get prices.

ALBANY, N. Y.—The Empire Lighting Company, of Poughkeepsie, was incorporated with a capital of $100,000 to manufacture and supply gas and electricity for light, heat and power in Poughkeepsie and the villages and towns in Dutchess County.

PHILADELPHIA, PA.—The Pennsylvania Manufacturing Light & Power Company will erect a battery of eight boilers and foundations for the same at Delaware Avenue and Robinson Street, and have given the contract for the same to Franklin M. Harris & Co.

SAN FRANCISCO, CAL.—The Yuba Electric Power Company has applied or an electric light and power franchise in Vacaville, Sonoma County, Cal. The line to Vacaville will be a part of the projected double-pole line to extend the company's transmission system to Vallejo.

AUSTIN, TEX.—The dam across the San Marcos River at New Braumfels, Tex., forming the lake that furnished the power for running the electric light plant of that town, was destroyed by the recent floods in that stream, but has been rebuilt and the plant is again in operation.

URBANA, OHIO.—The Urbana Electric Light & Power Company has renewed its contract with the city for seven years for 100 2000-cp lights, at $80 per year each, all night, and $75 for each additional light. The old contract price was $85 per light, the contract running five years.

INDIANAPOLIS, IND.—The Indianapolis Light & Power Company is putting in a storage battery in the Lyra-Casino Building. The estimated cost is $90,000. The battery will consist of 156 cells, 2½ ft. wide and 5 ft. deep, each of which will contain 51 plates and weigh 5000 lbs.

MARINETTE, WIS.—The Boom Company has decided to build a dam at Chappee Rapids and transmit the power electrically to Marinette and Menominee. Between 3000 and 4000 horse-power will be developed, and the cost will be about $200,000. The power will be used in both cities for the street car lines and for factory power.

ALBANY, N. Y.—The Lockport & Newfane Power & Water Supply Company has filed articles of incorporation, with a capital of $500,000. The directors are Henry J. Pierce, Burt Van Horn, of Buffalo; Willard T. Ransom, John A. Merritt, Harry L. Ransom, Senator Timothy Ellsworth, of Lockport, and William B. Rankine, of Niagara Falls.

GRANITE CITY, ILL.—The owners of the electric light franchise, the Messrs. Needringhaus, have closed a contract with the Venice Light & Power Company to supply Granite City with electric light. The dynamos now in use at the rolling mills for city lighting purposes will hereafter be used to supply power for the mill machinery.

PRINCETON, IND.—The Princeton Light & Power Company and the newly formed Hot Water Heating Company have consolidated, with a capital stock of $75,000. The hot water heating is to be done with the exhaust steam of the electric light plant. A day current for light service, with cheap rates for motors, will be a feature of the new organization.

OIL CITY, PA.—The Consolidated Electric Company, of Philadelphia, has completed negotiations and secured control of the Oil City Electric Light Company. The Consolidated Company assumed the bonded indebtedness of the local company, which is over $60,000. The Oil City Electric Company, which has been in the hands of a receiver, was released some time ago.

PORTLAND, IND.—The light committee of the City Council reported that for the last 11 months the arc lights used to light Portland, 65 in number, have cost only $62.72 for the entire period, this being under municipal ownership. When the plant was owned by private parties, $80 a light per annum was charged, the cost for the entire service now being less than was formerly paid for one light.

SAN FRANCISCO, CAL.—The Independent Electric Light & Power Company, San Francisco, is setting up in the new main power station four units, each including a Westinghouse generator having its armature carried on the main shaft of a McIntosh & Seymour vertical compound engine. The station is equipped with a 50-ton Shaw electric crane, which is used in erecting work. Each pair of large magnet frames weighs 48 tons.

AUSTIN, TEX.—No steps have yet been taken by the municipal authorities of Austin toward erecting an electric light and power plant to replace the structure which was destroyed by the bursting of the great dam across the Colorado River on April 7. The city is still in darkness, and is likely to remain so for some time to come, as there is no money available for making the desired improvement, and the limit of her bonded indebtedness has been reached.

KIRKWOOD, MO.—The city of Kirkwood is considering the feasibility of establishing an electric light and water works. At a special meeting of the Board of Aldermen, held last week, a special committee, composed of M. W. Cronin, Theodore Bopp, W. F. Warner and Mayor W. M. Daly, reported favorably as to the electric-light plant, but against the water-works plant until after the electric plant is in running order. Plans are being drawn for the latter plant.

ALTOONA, PA.—A number of Altoona capitalists with Mr. John Lloyd, of that city, at the head, have organized a new electric company, with a capital of $1,000,000, and they will erect an electric plant for the purpose of furnishing electric light and power to Altoona, Pa., and the surrounding towns. This enterprise, it is said, was started in opposition to the Philadelphia syndicate, which recently acquired the stock of the Altoona Electric Light & Power Company. Mr. Lloyd is the partner of Mr. A. J. Cassatt, the president of the Pennsylvania Railroad Company.

CHICAGO, ILL.—The Cicero Heat, Light & Power Company, which supplies the new 35th Ward with electric light, is insisting that Chicago pay the Austin bills for lighting since the city assumed the control of that district. At the time of annexation the town of Austin had a contract with the Cicero Company, extending for five years, to furnish electric light for $115 a light a year for 115 lights. Two years of that contract had expired, but since the town was added to Chicago the bills have been coming in but have not been paid. The matter will be passed upon by the City Council.

THE ELECTRIC RAILWAY.

MINERAL POINT, WIS.—An electric railway will be built from here to Highland, taking in Mifflin.

LA CROSSE, WIS.—The La Crosse Street Railway Company has been granted a franchise for extensions to its system.

TOLEDO, OHIO.—Road-bed construction work has been started on the Toledo, Tiffin & Sandusky Electric Railway.

SHEBOYGAN, WIS.—The extension of the Sheboygan street railway line to Plymouth and Elkhart Lake will be made by way of Glenbeulah, located between Plymouth and Elkhart.

BUCYRUS, OHIO.—The owners of the Ohio Central Traction Company of this place are preparing to construct an electric line between Wabash and Peru, Ind., a distance of 13 miles.

NORRISTOWN, PA.—A through trolley line from Philadelphia to Pottstown, and ultimately to Reading, is now an assured fact. The United Transportation Company is pushing the project.

BIRMINGHAM, ALA.—C. M. Shelley and others have petitioned the City Council for a franchise for a new street car line, which they propose to build and operate to the northern city limits.

STAMFORD, CONN.—The Stamford Street Railway Company proposes to extend its line to Glenbrook, a suburb northeast of this city. It is expected also that the line will be extended as far as Springdale.

SPRINGFIELD, OHIO.—A company headed by John P. Martin of this place is preparing to make application for franchises for an electric road between Springfield and Xenia, passing through Yellow Springs and Clinton.

MT. STERLING, OHIO.—The Chillicothe, Mt. Sterling & Columbus Electric Railway Company has made application for a franchise through the village of Mt. Sterling. Franchises for the balance of the road have been secured.

NEW HAVEN, CONN.—The Fair Haven & Westville Railway Company has acquired control of the New England Street Railway Company, which owns the controlling interest in the Winchester Avenue Street Railway Company of this city.

INDIANAPOLIS, IND.—The National Traction Company of Springfield, Ohio, has been granted a franchise through Clark County, Ohio, as a part of a connecting line between this city and Columbus, Ohio, which is to be completed next year.

COLUMBUS, OHIO.—The newly organized Central Market Street Railway Company has made application to the City Council for franchises. Incidentally the company proposes to build a line through Franklin and Fairfield counties to Lancaster.

ALBANY, N. Y.—The Lockport & Olcott Railway Company was granted permission by the State Railroad Commission to construct and operate an electric road from Lockport to Olcott, Lake Ontario. The length of the road will be about 18 miles.

FONDA, N. Y.—The directors of the Fonda, Johnstown & Gloversville Railroad Company have issued a call for a special meeting of the stockholders, to be held June 8, to vote upon a proposition to increase the capital stock of the company to $600,000.

TOLEDO, OHIO.—The City Council has granted a franchise to the Toledo Traction Company for an extension of its East Broadway street line on Woodville Street, from East Broadway to the city limits. The franchise is to expire in 1914 with that of the balance of the road.

ALLEGAN, MICH.—David Cornwell and Milton D. Owen, of Allegan, have been granted a franchise for an electric street railway to be constructed northward from Allegan to a point of junction with an electric road which will be built from Grand Rapids to Holland this summer.

DETROIT, MICH.—The tracks of the Detroit & Citizens' Railway at Gratiot and Mt. Elliott avenues, which were laid on a permit of the president of the council, were torn up on the night of May 23 by order of the council, which claims neither it nor the mayor had been consulted.

CONCORD, N. H.—The Railroad Commissioners have granted the petition of the Manchester Railway to increase its capital stock. The increase will bring the stock up to $250,000, and was asked for in order that funds might be raised with which to build and equip the new Goffstown branch.

WABASH, IND.—The franchise granted the Wabash River Traction Company for the use of the streets of Wabash has been extended to July 1 by the council. The company will decide whether it will build after the election in this township on the proposition of a $20,000 subsidy to the line.

POTTSVILLE, PA.—It is stated that the Pennsylvania Railroad Company has decided to build a trolley road from Pottsville to Primrose and beyond Minersville to Forestville, a distance of 12 miles. It is intended to use this portion of the road in a dual capacity as a steam and trolley system.

ST. JOHNS, MICH.—The required $100,000 in stock and donations in aid of the electric railway from Lansing to St. Louis, via St. Johns, Maple Rapids, Alma and Ithaca, has been secured and the road is assured. Mr. Mills, of Port Huron, the chief contractor, is now in Chicago arranging for the materials.

ROCKLAND, ME.—The annual meeting of the stockholders of the South Shore & Boston Street Railway was held here recently. It was voted to transfer the stock of the company to the Massachusetts Electric Company, which action will result in the addition of about 69 miles to the mileage of the Massachusetts Company.

NEW YORK, N. Y.—The five-cent fare to Coney Island has been abolished by the Brooklyn Rapid Transit Company, but the line sells coupon books which contain 20 tickets as commutation at $1 each. The Coney Island & Brooklyn Company has not raised the fare, and the officials state that the traffic has increased thereby.

TOLEDO, OHIO.—The promoters of the Toledo & Elmore Electric Railway have changed their plans and have decided to extend their road to Lakeside, with a branch to Catawba Island. With the exception of a six-mile strip through Port Clinton, the right of way for the entire road has been secured. Work of construction will begin shortly.

LEWISTON, ME.—The Lewiston, Brunswick & Bath Street Railway Company has elected the following directors: Herbert M. Heath, Augusta; Amos F. Gerald, Fairfield; E. J. Lawrence, Fairfield; M. I. Mason, E. Burton Hart and Theodore L. Peters, New York. Mr. Heath was elected president, and Mr. Mason, treasurer and general manager.

CLEVELAND, OHIO.—The Citizens' Street Railway Company was the only bidder for a franchise to build an electric road on Doan Street through the city and the neighboring village of Glenville. The company offers to sell six tickets for 50 cents and 24 for $1. This company has been making an effort to secure a foothold in the city and has failed several times.

MILWAUKEE, WIS.—The Street Railway Company has decided on further improvements of its new power plant at River and Oneida streets, and will add in the near future a duplicate of the two new engines already placed in the power house. The order for the new engine has just been placed with the Allis Company. It will have a capacity of 1500 horse-power.

INDIANAPOLIS, IND.—The Indianapolis, Morristown & Rushville Traction Company, a new organization, has secured a right of way paralleling the south side of the C. H. & D. track, with a view to constructing an electric line from Indianapolis to Cincinnati, via Rushville. J. N. Navin, J. H. Mahony and Edward W. Smith, of this city, are the promoters.

HAMILTON, OHIO.—Stockholders of the Ohio Southern Traction Company have decided to bond the road for $2,000,000 with the Cleveland Trust Company, of Cleveland. The bonds on the three original roads are to be taken up. Wages of conductors and motormen who have served more than one year have been increased from 17½ cents to 20 cents an hour.

CHICAGO, ILL.—Regular passenger service was formally inaugurated on the new Northwestern Elevated Railroad in this city on May 31. The road began service with 20 trains, capable of carrying 50,000 passengers. The new road is said to be the most complete in the world, embracing all the latest approved appliances for the movement of trains on elevated structures.

CHICAGO, ILL.—Under the terms of an agreement entered into by Corporation Counsel Walker and General Counsel Gurley, of the Chicago Union Traction Company, the city will receive $250,000, provided the courts declare valid the council ordinance which requires the company to keep the streets clean between its tracks, and to remove snow, dirt and other obstructions.

CLEVELAND, OHIO.—E. W. Moore, H. A. Everett, C. H. Stewart and others of this city are contemplating the construction of an electric road between Norwalk and Sandusky, passing through Monroeville and North Monroeville and connecting with the Toledo, Fremont & Norwalk Electric Railway. They also propose to build a road from Huron to Lorain, thus making a through line from Cleveland to Toledo.

ALBANY, N. Y.—The Queens Borough & Nassau County Railway Company, with a capital stock of $150,000, has filed a certificate of incorporation. The directors are Daniel Noble, Daniel Callahan, William L. Woodill, Matthew J. Smith, of Long Island City; Patrick J. Mara, Flushing, L. I.; Joseph Bermal, Middlesex Village; Joseph Meyerose, New York City; Edward J. McKeever Brooklyn; Henry P. Keith, Hempstead.

LYONS, N. Y.—The Newark & Marion Railway Company has been incorporated. Capital stock, $100,000. The principal office will be located in Newark. Directors for the first year are: Earnest V. Pierson, Frank D. Burgess, William H. Nicholoy, William H. Kelley, all of Newark; Caleb L. B. Hylee, Clinton N. Tylee and William C. Snow, of Pen Yan; Charles H. Scutt, of Marion, and Henry R. Sill, of Bluff Point.

LAPORTE, IND.—It is stated from reliable authority that the Northern Traction Company of this city has succeeded in negotiating the sale of $300,000 worth of bonds to Chicago capitalists to secure the building of the electric railway connecting this city with Michigan City. The Northern Traction Company claims it has a franchise, but its position is disputed by the County Commissioners, who allege that the franchise is no longer valid.

ALBANY, N. Y.—The Amsterdam & Hagaman Traction Company has been incorporated with a capital of $100,000 to operate a street surface electric road five miles long, from Amsterdam to Hagaman. The directors are William K. Archbold and Robert R. Reid, of New York; Paul T. Brady, Robert E. Drake and Simon B. Storer, of Syracuse; J. George Kaelber, of Rochester; W. Barlow Dunlap and Lewis E. Harrower, of Amsterdam, and William H. Cornell, of Buffalo.

CINCINNATI, OHIO,—The first electric roadbed in Ohio to be appraised for taxation was gone over May 29 by the auditors of Hamilton, Montgomery, Butler and Warren counties. This was the Millcreek Valley line, connecting with the lines of the Cincinnati Street Railway Company and those at Dayton, Ohio. The roadbed was appraised at $3,600 per mile and the four power stations as follows: Hamilton County, $21,000; Butler County, $18,000; Montgomery County, $18,000, and Warren County, $17,000.

WASHINGTON, D. C.—House Rep. bill No. 11650, to legalize the consolidation of certain street railways owned and operated by the Washington Traction & Electric Company, has passed the House, and will probably pass the Senate this session. This company has to pay the salaries of special policemen at all rapid transit grade crossings on its own lines and a proportion of the salaries of policemen guarding crossings where the Washington Traction Company crosses the tracks of the Capital Traction Company.

AUSTIN, TEX.—The Dallas, Fort Worth & Southern Electric Railway Company, with headquarters at Dallas, has been incorporated to build an electric railway from Dallas to Fort Worth, a distance of about 32 miles, thence in a southerly direction to the city of Cleburne, a distance of about 28 miles, making a total of 60 miles of road. The incorporators are George T. Bishop, J. B. Coffinberry, C. F. McKay, John Masterson, F. M. Osborne, Thomas L. Marsalls, C. A. Keating, W. L. Hall, Hyde Jennings, H. C. Edrington and W. G. Watterson.

CLEVELAND, OHIO.—According to an ordinance on the subject, the Cleveland City Railway Company has paid a $10 license on 248 cars, the number which it claimed to operate. A recent investigation into the company's affairs shows that the company is operating 367 cars, and an effort will be made to force it to pay the balance at once. An official of the company explains the discrepancy by the statement that many of their new cars are made so that the closed bodies can be removed and open bodies put in their place, thus saving a great expense in the number of trucks and motors required. The matter is to be investigated.

SIOUX CITY, IA.—The consolidation of all the street railway systems of this city under one management has proved to be a great financial success. The consolidation was accomplished just about a year ago and under the present management the operating expenses as a whole were greatly reduced, thus making an increase in the net earnings. There has also been an increase in the gross earnings, due largely to better times, and also to the fact that several extensions of the lines have been made, which greatly increased the traffic. The gross earnings of the various companies in 1897 were $118,593 and in 1898, $128,793. The net profits for the year ending June 1, 1900, will be in the neighborhood of $77,000.

NEW YORK, N. Y.—The Elm Street Connecting Railway Company, of New York, has been incorporated at Albany, with a capital of $20,000. The directors of the company are headed by Charles E. Warren, secretary of the Metropolitan Street Railway Company, which corporation is back of the new company. It is proposed to build a line on Elm Street from Centre Street to Great Jones Street and through Lafayette Place, a total distance of 6000 ft. The directors of the new company for the first year are Charles E. Warren, Sharon Graham, William A. Dibbs, Mark J. Martin, Clifford S. Beattie, Henry L. Jeffries, Andrew J. Loughlin, Lewis H. Thrall, all of New York City, and D. E. Clifford Moorehead, of Jamaica, L. I.

CLEVELAND, OHIO.—The lines built by the Cleveland, Berea, Elyria & Oberlin Electric Railway Company between Oberlin and Wellington and between Elyria and North Amherst were promoted as independent lines. A consolidation of the three lines has been effected under the name of the Cleveland, Elyria & Western Company. It is the intention of the new company to extend its line to Norwalk in the near future, where it will connect with the line between that city and Toledo, now building. The capital stock of the new company has been increased to $2,000,000, an increase of $1,000,000 over that of the old company. A bond issue of $1,500,000 was authorized, an increase of $1,000,000. At a meeting of stockholders held a few days ago, a temporary organization was effected by the election of the directors. The directory organized as follows: A. H. Pomeroy, president; A. E. Akins, vice-president; E. F. Schneider, secretary; E. T. Pomeroy, treasurer. The temporary organization will probably be made permanent.

THE AUTOMOBILE.

INDIANAPOLIS, IND.—The Adams Express Company is experimenting with an automobile wagon for delivery purposes in this city with satisfactory results.

CLEVELAND, OHIO.—The Washington Electric Vehicle Transportation Company, operating electric vehicles in New York and Washington, has made application for the privilege of operating buses through the parks and boulevards of Cleveland.

THE PACIFIC AUTOMOBILE COMPANY has been incorporated, with Los Angeles, Cal., as the place of business. Directors: W. Gillelen, W. F. Botsford, M. H. Jones, E. P. Clark, C. B. Boothe, A. L. Hawes and C. E. Lazier, of Los Angeles. Capital stock, $100,000; subscribed, $23,000.

THE NEW YORK AUTOMOBILE COMPANY, of Westfield, N. J., has been incorporated to manufacture and operate automobiles, etc. Capital, $200,000. Incorporators: C. G. Bliss, F. P. Slade, both of Westfield; E. Rode, M. I. Hester, H. B. Shute, all of Brooklyn; F. P. Slade, attorney, New York.

THE LITTLE & CONGDON COMPANY, of Amesburg, Mass., has been chartered to manufacture and deal in carriages, automobiles, etc. Capital, $100,000. Incorporators: J. H. Little, S. W. Congdon, J. Joyce, J. F. Finn, C. S. Mayo, all of Amesburg, Mass.; J. J. Donovan, attorney, Lawrence, Mass.

ROCHESTER AUTOMOBILE CLUB.—The new Automobile Club in Rochester, N. Y., has adopted a constitution and by-laws, and the following officers were elected: President, J. J. Mandery; vice-president, F. H. Bettys; secretary-treasurer, F. Sager; board of governors, C. J. Conolly, Dr. W. A. Keegan, Dr. George Waldron. The club has an auspicious start, with about 20 members, and a large increase is hoped for in a short time.

NEW INDUSTRIAL COMPANIES.

THE FOLLOWING new companies are of recent incorporation:

THE MAUMEE VALLEY ELECTRIC COMPANY, Toledo, Ohio. Capital stock of $100,000.

THE YALE MOTOR & POWER COMPANY has been organized in New Haven, Conn., with a capital stock of $500,000.

THE FEDERAL MOTOR VEHICLE COMPANY has been incorporated in Trenton, N. J., with a capital stock of $125,000.

THE SPRINGFIELD ELECTRICAL MANUFACTURING COMPANY, Saco, Me., to manufacture electrical apparatus. Capital, $10,000. Incorporators: H. E. Bosworth, B. C. Starr, H. R. Curtis, all of Springfield, Mass.; H. Turfield, attorney, Saco.

THE HERCULES MOTOR COMPANY, Elizabeth, N. J. Capital $25.000; to manufacture and deal in electrical apparatus. Incorporators: Charles G. Bliss, William I. Hester, Brooklyn, and J. C. Wamar, Newark.

THE ELECTRICAL INSULATING CONDUIT COMPANY, San Francisco, Cal., by W. Frank Pierce, Charles O. Poole, T. Trebell, A. A. Cantin and E. J. Zimmer, with a capital stock of $200,000.

THE MILLER-KNOBLOCK ELECTRICAL MANUFACTURING COMPANY, South Bend, Ind., has been incorporated. Capital, $125,000. Directors and promoters: J. C. Knoblock, C. M. Knoblock and W. H. Miller.

THE MOUNTAIN POWER COMPANY, Los Angeles, Cal., to generate and sell electricity. Capital, $500,000. Incorporators: J. S. Cravens, J. B. Miller, W. R. Staats, J. S. Terrance, all of Pasadena; H. Fisher, H. H. Sinclair, both of Redlands.

THE KEOKUK & HAMILTON WATER POWER COMPANY has been formed to develop the water power of the Des Moines rapids of the Mississippi River, Charles P. Birge, of Keokuk, Ia., being president. The company is composed of residents of Keokuk, Ia., and Hamilton, Ill., who intend to install an electrical system to distribute the current in their own towns and also in Quincy, Ill., and Burlington, Ia.

OBITUARY.

JAMES G. JENSEN, of the Empire China Works, Brooklyn Borough, New York, died at his country residence in Hempstead, L. I., June 3, at the age of 60 years. Mr. Jansen was widely known in the electrical trade, and was at one time quite a political power in Brooklyn.

PERSONAL.

MR. R. L. WEITHAS, formerly advertising editor of the *Electrical World*, has accepted the position of sales agent with the Hoyt Metal Company, with office at 150 Nassau Street, New York.

MR. E. P. BURCH has an interesting paper in the April number of the *Proceedings of the Northwest Railway Club*, on "The Utilization of Water Power for the Electric Railway System of Minneapolis and St. Paul." The paper is profusely illustrated and gives a complete engineering description of the system.

MR. GEORGE HELI GUY returned June 2 on the St. Paul from a two-months' visit to Europe. Mr. Guy entertained the saloon passengers with two piano solos at a grand concert aboard ship, in aid of several marine charities. Mr. Marconi, a fellow-passenger, also contributed to the entertainment with a piano solo.

MR. WALTER B. SNOW recently read a paper before the New England Cotton Manufacturers' Association on "The Application of Mechanical Draft to Stationary Boilers," which has been printed in pamphlet form. An interesting portion of the paper consists in designs for the installation of forced-draft systems, both in new and existing boiler plants.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is sending out pamphlets telling all about the line of Wurts lightning arresters it is agent for.

ST. LOUIS, MO.—The Commercial Electrical Company has increased its capital stock from $30,000 to $60,000. The assets are placed at $115,545.52, and the liabilities at $77,544.18.

MR. ROBERT L. McOUAT, of Indianapolis, has secured the services of Mr. V. C. Grace, who will represent him in the East. Mr. Grace is one of the leaders in the supply business, and ought to prove a valuable man for Mr. McOuat.

THE BURT MANUFACTURING COMPANY, of Akron, Ohio, is making an extensive display of Cross oil filters at the Paris Exposition and otherwise pushing themselves abroad. They will ship a large order to Brussels this month.

FIRE-DETECTING WIRE.—In a booklet just issued, the Montauk Multiphase Cable Company points out the merits of its cable for thermostatic purposes, which are attested to in a letter from Mrs. Joseph Pulitzer, who was a witness of its efficacy in saving life.

BRISTOL RECORDING INSTRUMENTS.—A new partial list of Bristol recording instruments includes 208 different varieties of instruments for pressure, temperature and electricity. The electrical instruments include voltmeters, ammeters and wattmeters, both for direct and alternating current.

SUMTER, S. C.—We are informed by the Sumter Telephone Manufacturing Company that an item which appeared in this department in the issue of May 26, stating that an injunction had been secured against the use of its firm name, is incorrect—the application for the injunction having been refused.

GREENFIELD FLEXIBLE STEEL-ARMORED CONDUCTORS.—The Sprague Electric Company, New York, has issued a bulletin relative to the Greenfield flexible steel-armored conductors. It tells of the advantages of these conductors for general purposes, and particularly for ship, factory and mill wiring.

MANHOLE CABLE HANGERS.—Macferran & Heywood, 3314 Haverford Street, Philadelphia, Pa., have issued a circular describing and illustrating in detail its line of adjustable manhole cable hangers. The illustrations show very clearly the advantages of this device in simplicity, durability, convenience and mechanical finish.

THE SHEFFIELD CAR COMPANY, Three Rivers, Mich., is sending out a sheet giving dimensions of the Sheffield standard motors and dynamos, which are made in various sizes for 110, 220 and 500 volts. These machines are claimed to be thoroughly up to date, and are guaranteed to be equal in efficiency to any other make.

A FOLIO CATALOGUE.—The Phœnix Glass Company has issued a handsome cloth-bound catalogue of folio size (12 ins. x 14 ins.), illustrating and listing the various electric and gas globes, shades, etc., of its manufacture. The engravings are extremely well executed, and, being printed on heavy plate paper, are effective in appearance.

BENJAMIN F. KELLEY & SON, 91 Liberty Street, New York, have recently issued some trade literature on the subjects of "Exhaust Pipe Heads;" "Berryman Water-Tube Feed-Water Heater and Purifier," and the "Improved Economical Boiler and Tank Feed Pumps." The principal advantages of these various devices are briefly described.

THE WESTERN ELECTRIC COMPANY, Chicago, has closed a large contract for generators and motor equipment for the new shops of the Colorado & Southern Railroad, now being built in Denver, Colo. The contract for the electrical equipment in the Willard Hotel, Washington, D. C., has been awarded to the Western Electric Company.

MONEY TALKS is the title of a neat folder issued by the International Correspondence Schools of Scranton, Pa. It gives letters from some of its students testifying to their receiving increased salaries as a result of their increased knowledge. Some other interesting matter is also given to show how easy a technical education may be obtained by correspondence.

THE LAKE SHORE & MICHIGAN SOUTHERN RAILWAY operates its trains from Boston to Cleveland over the Boston & Albany, and from New York to Cleveland over the New York Central & Hudson River Railroad, with through sleeping-car service between these points. It gives the most direct service between Cleveland, New York, Boston, Buffalo and Chicago.

STERLING ELECTRIC MOTOR WORKS BURNED.—On the night of May 15 the works of the Sterling Electric Motor Company, 22 to 28 North Canal Street, Dayton, Ohio, were entirely destroyed by fire. The patterns and drawings were saved, however, and the company was fully insured. Temporary quarters are now being fitted up, and the company is now running full time.

HYDRAULIC PUMPS.—The Watson-Stillman Company has issued a new catalogue (No. 56) relating to hydraulic pumps, the first of a series of sectional catalogues in which the pumps most frequently made by the Stillman Company are described and illustrated. The catalogue includes a telegraphic code. Some of the former cuts have been replaced by new ones, and about a score of new ones are introduced.

SWITCHBOARD INSTRUMENTS.—The S. E. I. Company, Syracuse, N. Y., has issued a series of circulars of somewhat novel arrangement and design. They relate to the company's switchboard instruments and each conveys some telling fact concerning the same. They are printed on brilliantly colored paper and will be mailed to dealers in electrical goods throughout the United States, one each month.

WOOD PRESERVATION.—The Barschall Impregnating Company, 31 Nassau Street, New York, has issued a pamphlet entitled "A Treatise on Wood Preservation," giving investigations by eminent German scientists and authorities on this subject, with particular reference to a new German process of wood preservation. This process, due to Haselmann, is being introduced in this country by the Barschall Company.

THE NORTH ELECTRIC COMPANY, Cleveland, has just issued attractive circulars describing its "1900" dry battery for telephone work, also the North carbon porous cup cell, which the company claims is the best open-circuit wet cell ever used for telephone work. The North Company is preparing a considerable amount of interesting and instructive literature on telephone construction for distribution at the telephone convention to be held in Cleveland this month.

E. E. CLOCK, Passaic, N. J., has secured a contract for the equipment of a new packing house of the Passaic Beef Company, which is a branch of the G. H. Hammond Packing Company. The equipment consists of one 100-light, direct-connected set, one 17½-kw, belted generator, one 15-hp motor and an electric elevator. All of the machines are of the latest Crocker-Wheeler manufacture. This is the first Hammond plant to be electrically equipped, and will no doubt lead to more equipments of the same nature.

THE FARR TELEPHONE & CONSTRUCTION SUPPLY COMPANY, of Chicago, Ill., will occupy Room 306, Electric Building, at Cleveland, June 12, 13 and 14, during the convention of the Independent Telephone Association of the United States. This company will have a fine display consisting of several different kinds of telephones, generators, magneto bells, switchboard drops, etc. President C. W. Farr and General Manager E. W. Hurst will be present and glad to meet every one interested in telephones.

THE PRATT INSTITUTE MONTHLY.—The May number of the Pratt Institute *Monthly* is issued by the department of science and technology. It contains a number of interesting articles, those bearing signatures having the following titles: "The Need for Secondary Technical Education," by A. L. Williston; "Some New Pieces of Physical Apparatus," by J. M. Jameson; "Technical Education in Germany," by E. M. L.; "Apprenticeship in America," by W. J. Kaup; "The Place of Correspondence Instruction in Technical Education," by A. L. Rice.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, last month enjoyed what it terms its "record-breaker." Its business amounted to about $150,000, the greater part of it being in domestic orders and for power machines. Among the more conspicuous orders were two for 150-kw generators, three-bearing, belted machines, and two 35-hp, two 20-hp, one 30-hp, two 5-hp and one 45-hp motors for the United States Dressed Beef Company, New York, and one from the U. S. Navy Yard, Brooklyn, for a 200-kw engine type generator to furnish power in driving the machinery.

THE GENERAL INCANDESCENT ARC LIGHT COMPANY had the most general line of electrical fittings, sundries and supplies for central-station use shown at the recent N. E. L. A. Convention. A list of these would simply be a category of the products of this and its associated concerns. Among the most interesting of the exhibits of this company was its most recent line of arc lamps, embracing a series alternating as well as the other usual types and the special series-multiple form made by this company. In addition, there were underground fittings, switches, incandescent lamps, motor starters, cut-outs for enclosed fuses, etc., etc.

THE SUMTER TELEPHONE MANUFACTURING COMPANY, Sumter, S. C., has now one of the largest and best-equipped telephone plants in the country. It has been constantly running since put in operation, employing a large force of employees manufacturing parts preparatory to the assembling of lines of telephones and exchange apparatus, which will soon be placed on the market. Everything entering into the construction of instruments and apparatus is manufactured in the works, and by reason of extensive facilities, the Sumter Company is in position to serve its customers promptly with modern apparatus of the highest electrical and mechanical efficiency.

THE ERICSSON TELEPHONE COMPANY, 296 Broadway, New York City, will have an exhibit of its telephones and sample-imported switchboard in Room 215 Electrical Building, Cleveland, during the telephone convention in that city on June 12, 13 and 14. It is expected that the company will be represented by Messrs. J. H. Montague and J. F. Hemenway, who will be pleased to see all of their friends, and to explain the merits of their goods. The exhibit will be made in connection with that of the McIntosh-Huntington Company, the company's Cleveland distributing agent, who is assisting by arranging for outside connections, which will enable visitors to call outsiders from the telephones.

A LARGE PLANT OF ECONOMIZERS.—Among many large orders recently received by the Green Fuel Economizer Company, of Matteawan, N. Y., is one for the Manhattan Railway Company, New York City, for its new 100,000-hp plant. These economizers are to be installed in the Manhattan Railway Company's new power house now building at Seventy-fourth Street and East River, New York City. When this plant is completed it will be the largest plant of economizers running in the world. This large order following so closely that of the Third Avenue Railroad Company's Kingsbridge power house, for economizers to be applied to 32,000 B. H. P., clearly evidences the high appreciation of engineers of the value of the economizer as applied to power plants.

FOCUSING LAMPS.—At the Printers' Exhibition, just closed at Grand Central Palace, one of the exhibits which attracted considerable attention was that of Charles J. Bogue, of 209 Centre Street, New York, showing how essential electricity has become in the process of photo-engraving. Mr. Bogue showed several types of focusing lamps for this purpose—automatic, direct and alternating-current, also hand-feed. A special hand-feed lamp has recently been constructed with automatic strikers to work in series on constant potential. Mr. Bogue's lamps are now in use by the New York *World, Journal, Tribune* and other large dailies, also *Harper's* and most of the photo-engraving establishments in New York City and throughout the country. Mr. Bogue reports trade as active in searchlights, it having opened up rather earlier than usual this year. He makes searchlights in all sizes to suit all requirements, from the small portable type, 8 ins. in diameter, to the large marine type upward to 30 inches.

ELECTRIC HEATING.—The Simplex Electric Company, of Cambridgeport, Mass., has completed the installation for the New England Hospital for Women and Children of six complete kitchen outfits of electric-heating apparatus; a complete laundry equipment consisting of electric smoothing irons and electrically-heated ironing rolls; a number of instrument sterilizers, hot-water tanks, heating pads, etc. A complete laboratory outfit has also been installed for John Alden, chemist, of Pacific Mills, Salem, Mass.; a large kitchen and laundry for Dr. Cowles, of the McLean Asylum at Waverly, Mass. The Arbuckle Sugar Refinery, of New York, has installed a complete electric kitchen for service to employees. The Simplex Company also reports recent orders for stateroom heaters, food warmers and curling irons for new ships of the North German Lloyd Line. The stateroom heaters for the new Hamburg steamer Deutschland were furnished by this company, as well as those for the Oceanic, the two largest steamers afloat.

THE WESTERN ELECTRIC COMPANY, of Chicago, had on exhibition during the N. E. L. A. Convention a circuit of series alternating lamps in the auditorium engine room, in addition to its exhibit of various types of the "Petite" lamp in one of the hotel parlors. The series lamp is a new development with this company, so that a few words of explanation may be in order. The lamp itself is of the differential variety and is magnetic—that is, the repulsion effect of a short-circuited secondary is not made use of as it is in the constant-potential alternating lamp made by the same company. No automatic-regulating apparatus is installed to keep the current in the line constant in case of a variation of the number of lamps. Each lamp, when cut out either automatically or by hand, is replaced in the line by an equivalent reactive coil. An ammeter is provided for the station attendant to observe the current flowing and correct any rise above normal by inserting a reactive coil or lowering the voltage. In case a large proportion of the lamps are cut out suddenly by two grounds, the remaining lamps are protected by fuses inserted in series with the line for this purpose.

THE WILMARTH & MORMAN COMPANY, a corporation recently organized at Grand Rapids, Mich., has purchased the entire business, including factory, patents and good will, of the Fuller Manufacturing Company, of Kalamazoo, Mich., and succeeds that company in the manufacture of the "New Yankee" drill grinders. The new corporation is officered as follows: President, L. T. Wilmarth, of Grand Rapids, Mich., founder of and for nearly 11 years secretary, treasurer and general manager of the Grand Rapids Cycle Company, manufacturers of "Clipper" bicycles, and which company has recently sold out to the American Bicycle Company; vice-president, S. A. Morman, also of Grand Rapids, who was for over seven years president of the Grand Rapids Cycle Company, and is interested in various other industries; secretary, C. E. Meech; treasurer, Charles D. Fuller, former owner of the Fuller Manufacturing Company. With abundant capital, largely increased facilities and capacity, the Wilmarth & Morman Company plans to properly care for the rapidly increasing foreign and local demands for the "New Yankee" drill grinder, and to make this an exclusive business rather than a "side line," and so merit the continued favor of machinery users. The home office of this company will be at Grand Rapids, where all mail may be addressed, although the offices and factory will be maintained at Kalamazoo until about Sept. 1; consequently, mail addressed to either city will reach the company. The Wilmarth & Morman Company already has in press a fine art catalogue, said to be by far the finest Drill-Grinding Machine catalogue ever issued.

SACHS "NOARK" FUSES were exhibited at the recent National Electric Light Convention by the H. W. Johns Manufacturing Company, of New York, and its Western representative, the Manville Covering Company, of Chicago and Milwaukee. Mr. Joseph Sachs, the deviser of these appliances, was in constant attendance during the convention. "Noark" fuses and protective appliance are certainly a high development in the direction of safe and accurate protective appliances. Fuses of this character, guaranteed to be absolutely non-arcing under any excess current condition at voltages from 110 to 30,000 volts, were shown in current capacities as high as 1000 amperes on 220 and 500 volts. The peculiar action of this device, upon which its arcless operation depends, consists in effecting a combination between the fuse wire and a filling material around it, which are enclosed in a fibre tube closed at the ends by terminal caps. The absorption of the gases of disruption in this way insures an arcless action-operation of the fuse, but, at the same time, its condition is at all times visible by means of a small indicator wire on the exterior of the casing. Hence, the motto, "Noark fuses do not arc, but indicate." Mr. Sachs has made a careful study of the fuse protective-device problem, and is ready to provide "Noark" appliances capable of breaking without arc under any electrical service condition. Some substantial orders were obtained during the convention for these "Noark" fuses and the various cut-out fittings with which they are furnished. In fact, the maxim, "Ounces of protection save tons of electrical apparatus," as one of the "Noark" circulars informed the delegates, seemed to be appreciated.

THE MANHATTAN GENERAL CONSTRUCTION COMPANY, of Newark, N J., had the most extensive of the many arc light exhibits at the N. E. L. A. Convention. In the basement of the hotel this company had placed a 50-kw, two-phase, 1100-volt, 60-cycle alternator, which was driven by a direct-current motor. This alternator supplied two circuits of series alternating lamps, one of 12 lamps in a parlor occupied by the company's exhibit and another of 10 lamps on the hotel's regular arc-light standards in the street. The former circuit also contained incandescent lamps and instruments to show the constancy of the current obtained by the regulator when the arcs were cut in or short-circuited. To connect up these circuits required 2000 ft. of lead-covered wire. In addition to the two regulators in use on these two lines, the company showed a number of its standard sizes of the latest type, ranging in capacity from 12 to 100 lamps. The lamps shown in operation were of the latest type, with shunt-regulating coils and no series coils whatever. The shunt coil is concentric with the carbon holder, and a dash pot, also concentric, is provided to prevent the shunt coil from striking the arc too suddenly, the dash-pot cylinder being cut away so that over the normal range of operation, once the arc is formed, there is no retardation or friction. The cut-out is electro-mechanical, the regulating magnet, in case it drops the clutch to its lowest limit, closing a by-pass around the arc, but through a magnet which holds the contact closed. With the shunt form of regulator used in this lamp, the power factor is improved over that of the series lamp, and, if desirable, the candle-power of the lamps may be changed by simply varying the current, the arcs in this case remaining of constant voltage and not shutting up as they do in the differential form.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED MAY 29, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

650,364. ELECTRIC RAILWAY SYSTEM; A. H. Armstrong, Schenectady, N. Y. App. filed April 8, 1899. (See Current News and Notes.)

650,370. APPARATUS FOR STARTING MOTORS; Wm. Cooper, Cincinnati, Ohio. App. filed March 24, 1900. In the case of an alternating-current motor a transformer or equivalent is interposed in starting and withdrawn when the motor has reached speed. The apparatus, however, is so arranged that the transformer can be again introduced if it is desired to decrease the speed of the motor. In the case of direct-current motors, the direct current is changed to alternating current for the purposes of the invention, then rectified to direct current before reaching the motor.

650,381. FAC-SIMILE TELEGRAPH; W. P. Dunlany and H. R. Palmer, Cleveland, Ohio. App. filed March 31, 1899. This is an instrument for telegraphing pictures and drawings, the message being received and recorded by the blows of a hammer instead of by an electro-chemical change in the receiving surface.

650,384. TROLLEY; T. M. Feift, Sioux City, Ia. App. filed Oct. 2, 1899. The fixed axle is provided with a number of sockets each containing graphite for lubricating purposes, the graphite being held in contact with the bearing surface of the wheel by springs.

650,416. KNIFE SWITCH; C. G. Perkins, Hartford, Conn. App. filed Jan. 17, 1900. The movable switch member is of insulating material, but carries a fusible conductor which makes suitable contact at each end with terminals.

650,417. PORTABLE STORAGE BATTERY CELL AND CONTAINING CASE THEREFOR; D. P. Perry, Chicago, Ill. App. filed April 28, 1899. Structural details adapting the battery to motor vehicles.

650,418. CASING AND LAMP SOCKET FOR PORTABLE ELECTRIC LAMPS; D. P. Perry, Chicago, Ill. The device consists of separable base receiving and key socket portions of novel construction, the former being attached to a glass-enclosed reflector part, while the latter is mounted within a shell arranged to receive the reflector part.

650,425. AUTOMATIC MAGNET CIRCUIT BREAKER; W. M. Scott, Philadelphia, Pa. App. filed Jan. 31, 1898. Details of construction.

650,426. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed March 15, 1897. Consists of the connecting plug, the supervisory signal associated therewith and local battery circuits controlled by a switch in the normal resting seat of the plug, adapted to create the same condition in the magnet of the signal which is attained during the employment of the plug and the signal by the use of the station telephone.

650,430. ELECTRIC CURRENT OR MOTIVE FORCE CONTROLLER; A. L. Stevens, New York, N. Y. App. filed Oct. 28, 1899. Details of construction of a controlling switch.

650,432. FLUSH BOX FOR ELECTRIC SOCKETS AND PLUGS; C. H. Stewart, Chicago, Ill. App. filed Jan. 12, 1900. The box containing the switch is flush with the wall and contains two hinged doors through which access to the switch may be obtained.

650,445. INSULATOR; E. Zertuche, Puebla, Mexico. App. filed Oct. 28, 1899. The insulator has a Z-shaped passage through which the wire leads.

650,452. SYSTEM OF TRAIN CONTROL FOR ELECTRIC MOTORS; F. E. Case, Schenectady, N. Y. App. filed April 12, 1898. (See Current News and Notes.)

650,485. SIGNALING APPARATUS AND COUNTERS FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed June 15, 1898. 650,486. App. filed June 17, 1898. 650,487. App. filed Feb. 9, 1899. 650,489. App. filed Oct. 21, 1899. These patents cover various details of minor importance.

650,488. TOLL-COLLECTING APPLIANCE FOR TELEPHONE PAY STATION; C. E. Scribner and S. R. MacBerty, Chicago, Ill. App. filed April 12, 1899. Consists of devices and circuits permitting the association of the toll box or coin-collecting appliance of the pay station with the supervising and signaling mechanism of the telephone switchboards, such as are commonly in use in an operative organization capable of attaining a high degree of efficiency and reliability in the use of the pay station.

650,499. ELECTRIC BELT; P. Wenigman, Chicago, Ill. App. filed March 14, 1900. Consists of a flexible band or strip of material adapted to encircle the body, upon one side of which are deposed the electrodes, while upon the other side are mounted a plurality of dry battery cells permanently connected together with a regulating device in series with the electrodes and battery.

650,531. INCANDESCENT LAMP; Reginald A. Fessenden, Allegheny, Pa. App. filed Aug. 25, 1899. An improvement on the means described in a previous patent for starting into action an electrolytic lamp. A high-potential current is used for heating the pencil to incandescence and a low-potential current for maintaining it in that condition, the change from one potential to the other being effected automatically and controlled by or dependent upon the conductivity of the conductor.

650,536. PROCESS OF MANUFACTURING SUBSTANCES RESEMBLING MANNITE; Arthur Hough, San Francisco, Cal. App. filed Oct. 10, 1899. Consists in treating an aqueous solution of glucose by subjecting the same to electrolytic action of an electric current under such conditions as to evolve hydrogen in the solution.

650,548. TELEPHONE EXCHANGE SYSTEM; W. Smith, Ridley Park, Pa. App. filed June 9, 1899. An object of this invention is to provide a generator system of the "central energy" character, in which the energy is applied uniformly to the speaking apparatus of two connected lines, and is only in use when two lines are connected with each other.

650,550. ELECTRIC CABLE; M. I. Baird, Glenfield, Pa. App. filed Aug. 25, 1899. A cable consisting of two or more sections, each provided at each end with a sealing head the conductors being electrically continuous through all the sections and being exposed between the sealing heads of adjacent sections.

650,551. SYSTEM OF ELECTRIC DISTRIBUTION; M. I. Baird, Glenfield, Pa. App. filed Dec. 1, 1899. In a system for the distribution of electric currents, a main cable branch conductor electrically connected to the conductors of the main cable, and supported parallel with the main cable from its point of electrical connection to the main cable to the point of "lead out," and means for holding the branch conductors fixed at the points of "lead out."

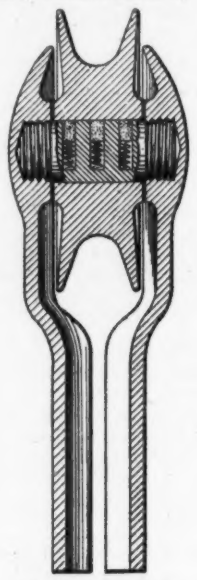
650,558. PROPELLING MECHANISM FOR BOATS; T. B. Hatch, Chicago, Ill. App. filed May 18, 1899. A water-tight electric motor carrying a propeller on the end of its armature shaft, is intended to be submerged at the stern of a boat.

650,570. SIGNALING SYSTEM; L. C. Smith, Torrington, Conn. App. filed April 27, 1898. An arrangement of circuits for factory signaling.

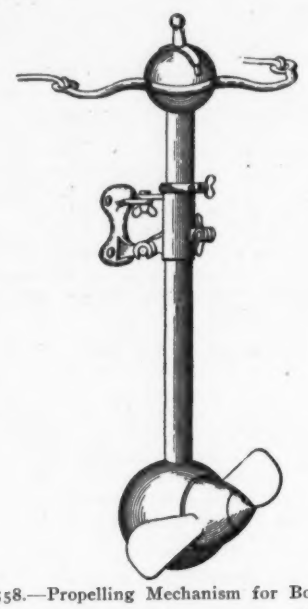
650,582. RHEOSTAT SWITCH; R. Fuller, Detroit, Mich. App. filed Oct. 27, 1899. Structural details.

650,585. ELECTRIC RAILWAY; J. B. Larkin, Pittsburg, Pa. App. filed Nov. 3, 1899. 650,586. App. filed Dec. 28, 1899. These are conduit systems in which the slot is closed by a horizontally moving plate which is thrust aside by rollers carried by the car.

650,602. ELECTRIC FUSE OR CUT-OUT; L. W. Downes, Providence, R. I. App. filed Oct. 18, 1899. This is a plug type of fuse, in which the fusible strip is surrounded by an air chamber.



650,384.—Trolley.



650,558.—Propelling Mechanism for Boats.

650,609. CONTROLLING LEVER FOR MOTOR CARRIAGES; C. R. Otis, Yonkers, N. Y. App. filed April 2, 1900. Detent for holding the operating lever out of operation is released by pressure against the back of the seat.

650,628. MAGNETIC BRAKE; E. M. Barnes, Cleveland, Ohio. App. filed April 16, 1899. A magnetic brakeshoe is suspended on the truck of a car over the track with provision for such movement that when a current is passed through the tube it will move into engagement with the track and retard the car.

650,646. APPARATUS FOR ELECTROLYTIC REDUCTION OF ORES; F. H. Long, Chicago, Ill. App. filed June 22, 1898. (See Current News and Notes.)

650,666. APPARATUS FOR CONTROLLING ELECTRIC MOTORS; A. W. Berresford and H. Wiegand, Westfield, N. J. App. filed March 22, 1900. Structural details.

650,668. ELECTRIC LIGHTER FOR INCANDESCENT BURNERS; G. Burkhardt and W. Scheuber, Chicago, Ill. App. filed Feb. 8, 1900. Details.

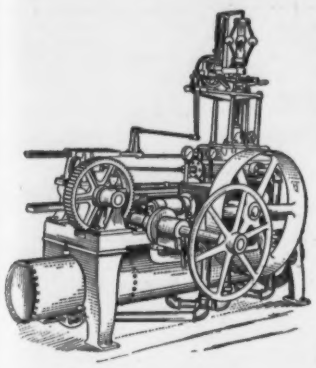
650,765. TROLLEY; G. R. Pomb, Loraine, Ohio. App. filed Oct. 13, 1899. A pneumatic cylinder and piston are arranged to actuate the trolley pole, the air being controlled by an electric valve.

650,677. MEANS FOR OBTAINING SYNCHRONOUS ROTATION OF DYNAMIC-ELECTRIC MACHINES; Henry Geisenhöner and Charles D. Knight, Schenectady, N. Y. App. filed Nov. 10, 1899. Relates to mechanical details of the copper "bridge" patented by E. W. Rice, Jr., and E. J. Berg, and applied to the poles of rotary converters to prevent "hunting."

650,704. AUTOMATIC APPARATUS FOR PROTECTING COMPOUND-WOUND DYNAMOS; C. N. Black, New Haven, Conn. App. filed Aug. 15, 1898. (See Current News and Notes.)

650,808. SECONDARY BATTERY; J. P. Clare, Quincy, Mass. App. filed Nov. 22, 1899. The envelop for active material has porous walls built up in sections cemented together by an acid-proof cement.

650,814. SUSPENSION DEVICE FOR TROLLEY WIRES; J. W. Scully, Hyde Park, Mass. App. filed Feb. 5, 1900. The grooved strip in which the wire is held is detachably connected with a body portion by a slip joint.



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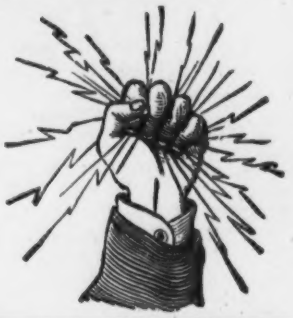

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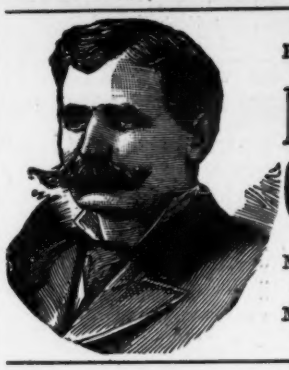

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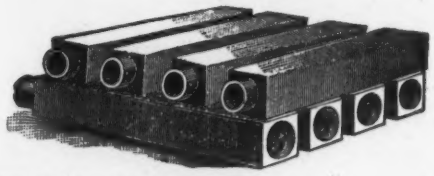

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1	270	"	T.-H. comp., self-oiler.
1	300	"	Eickmeyer.
1	340	"	Eddy, self-oiler, compound.
2	350	"	Hawkeye, comp. wound.
1	350	"	National, self-oiler, comp.
1	350	"	Edison, 20 K.W., self-oiler.
1	350	"	Columbian, M.P. self-oiler.
1	360	"	Rockford, self-oiler, comp.
1	450	"	Edison, 25 K.W., self-oiler.
1	400	"	Wood, M.P., self-oiler.
1	450	"	Rockford, self-oiler.
1	540	"	Edison, 30 K.W., oil cup.
4	540	"	Edison, 30 K.W., s. o., comp.
1	540	"	Westinghouse, 8-pole, s. s., 30 K.W., self-oiler, new.
1	600	"	E. & C., slow speed, M.P., self-oiler, compound.
1	600	"	Eickmeyer.
2	700	"	Siemens & Halske, 40 K.W., M.P., slow speed.
2	700	"	Westinghouse, 10-pole, s. s., 40 K.W., self-oiler, new.
1	800	"	Rockford, s. o., new arm't.
4	800	"	Edison, 45 K.W., self-oilers.
1	1350	"	Waddell-Enz, 80 K.W., M.P., for direct connection.

BOOSTER SET.

1 Siemens & Halske, M.P., iron clad, type booster set, for raising 275 ampere, 26 volts or less; motor, 90 ampere, 110 volts; generator, 275 ampere, 26 volts.

220-VOLT GENERATORS.

1	10 K.W.		T.-H., self-oiler.
1	25	"	Edison, self-oiler.
1	35	"	E. & C. M.P., slow speed.
1	45	"	Edison, self-oiler, new arm't.

500-VOLT GENERATORS.

1	20 K.W.		Edison, new armature.
1	25	"	Commercial, self-oiler.
1	25	"	T.-H., self-oiler, D25, comp.

VIEW FROM ARMATURE DEPT., GREGORY ELECTRIC CO.

NOTICE.—All machines are actually in stock. All machines are guaranteed. Write for particulars and send for MONTHLY BARGAIN SHEET, with net cash price.

500-VOLT GENERATORS.

1	25 K.W.		Edison, self-oiler.
1	30	"	Jenney, self-oiler.
1	35	"	Jenney, self-oiler.
1	35	"	Mather, self-oiler.
1	45	"	Edison, comp., self-oiler.
1	150	"	Detroit, M.P., comp. s. o.

DIRECT CONNECTED RAILWAY GENERATORS.

1 100 H.P., 500-volt Westinghouse, Kodak set Westinghouse generator and Westinghouse comp. engine 14x24x14, all complete, fine.

ALTERNATING GENERATORS.

1	350-light		Thomson-Houston, A18.
1	600	"	Bain, 30 K.W., self-oiler, new toothed armature.
1	600	"	T.-H., A6, 30 K.W.
1	600	"	T.-H., 30 K.W., two-phase, 1100 volts.
1	650	"	T.-H., A35, s. o.
2	750	"	Westinghouse, 37½ K.W.
1	900	"	60-cycle Westinghouse, 45 K.W., s. o., with newly wound toothed armature.
1	1000	"	Wood, 50 K.W., s. o., toothed armature.
1	1200	"	Westinghouse, 60 K.W., self-oiler, toothed armature.
1	1400	"	Westinghouse, 70 K.W.
2	6000	"	Westinghouse, 300 K.W., toothed armature, composite wound, self-oilers, out board bearings.
1	6000	"	Westinghouse, 300 K.W., 2200 volts, toothed armature, composite wound, self-oiler, out board bearings.

ARC DYNAMOS.

1	20-light	2000	C.P.	Western Electric.
1	25	2000	"	T.-H.
1	30	2000	"	Western Elec., s. o.
1	30	2000	"	Brush, No. 7.
2	35	2000	"	T.-H., LD2.
1	40	2000	"	Wood, No. 7.
2	40	2000	"	Western Elec., s. o.
1	45	2000	"	T.-H., M12, ring art.
4	45	1200	"	Brush, No. 7.
1	50	2000	"	Excelsior, latest type.
2	50	1200	"	T.-H., LD12.
1	50	2000	"	Western Elec., s. o.
1	50	2000	"	Brush, No. 7½.
2	60	2000	"	Western Elec., s. o.
1	60	2000	"	Westinghouse, tooth. arm't, 6-pole, D. C., s. o., complete with exciter.